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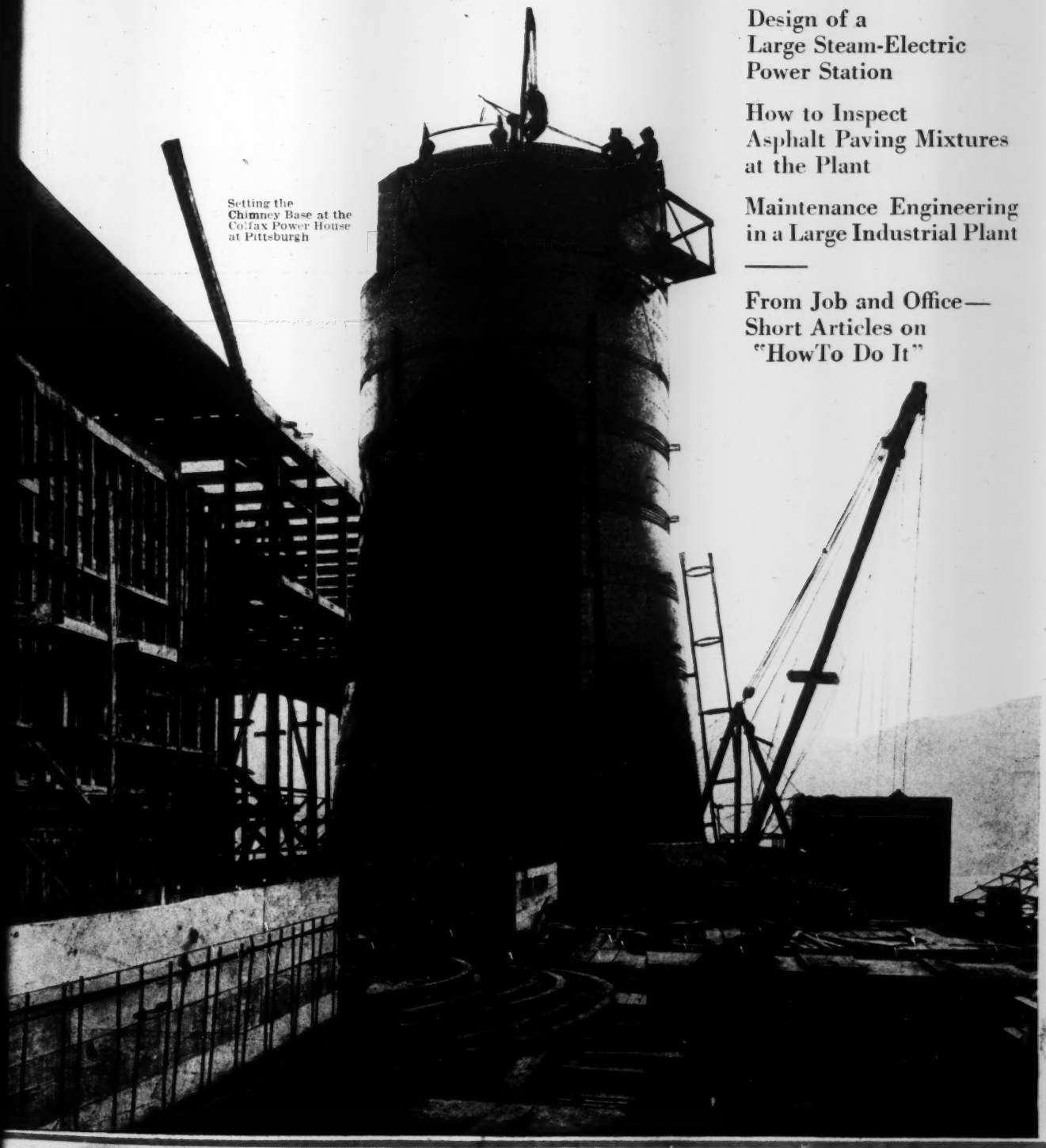
Engineering News-Record



Setting the Chimney Base at the Colfax Power House at Pittsburgh

Design of a Large Steam-Electric Power Station

How to Inspect Asphalt Paving Mixtures at the Plant

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 89 — NEW YORK, DECEMBER 28, 1922 — Number 26

Personal Liability

ADVANCE is being made, steady if slow, towards establishing the doctrine of personal liability for preventable accident. During the past year or two several cities have been added to the small list of those which place the cost of firefighting on the person whose negligence caused the fire, and about a dozen communities now follow this practice. The doctrine is quite general, however. It applies to other forms of accident than fire, to railroad operation and to building, for instance, and we trust that in no too far distant time it may be made practically effective here, by the joint force of statute, popular conviction and judicial interpretation. It tends to build up, in place of our well-recognized national tendency to neglect and carelessness, the habit of taking care. The forest fire, the broken arm and the train wrecked by a rotted tie will all be less common when that habit has become established.

Unique Sewage-Pump Bids

CAPITAL charges as well as operating expense are less frequently taken into account than they should be in comparing the cost of several ways of accomplishing the same end in municipal work. A notable instance of taking both into account is afforded by the recent electric-driven sewage-pump contract letting at Syracuse. The comparison was not between electric and other active power for the pumps but to determine which of two types of electric motor equipment—slip-ring and brush-shifting—would be most economical. Itemized bids were invited for the various units of each class of equipment. To reduce the bids to a comparative basis, amortization charges were figured on the equipment and to the total for each type was added the annual charge for current, based on the contractor's guarantee as to amount of current and the unit cost of the current to the city. More common use of such refinements in bidding may be expected with progress in engineering and in municipal government.

Better Equipment Maintenance

MAKERS and users of construction equipment and materials are both striving toward the common objective of securing for their machinery the maximum service on the job. Some contractors, after they have purchased their plant, make the mistake of paying little or no attention to it until a serious breakdown occurs. Then the job may have to be shut down until repairs can be made, resulting in idleness of at least a part of the working force and a setback to progress schedules. Oftentimes this result is due to the lack of an inexpensive repair part which, if it had been kept in stock or ordered in advance, could have saved its actual cost many fold. When repair parts are needed they are generally needed badly and the contractor sends in the usual "rush" order to manufacturers of equipment for replacements. Time and again shipments of this sort are delayed because the individual sending in the order fails to be specific as to what is wanted. The manufacturer puzzles over the meager information he receives and often has to wire back for more detailed instructions. There is an opportunity for a great deal more co-operation than now exists between makers and users of construction machinery. In the hope that a recital of actual experiences may eliminate some of the difficulties *Engineering News-Record* started in its department "From the Manufacturer's Point of View" in the Dec. 14 issue a discussion in which the equipment makers tell of some of the actual conditions governing the supply of repair parts. Both contractors and engineers should follow the discussion, which continues this week. It will point out some of the things that equipment users do that should not be done and may indicate some of the things they might do in the interests of better service. This general subject of equipment maintenance, long neglected, is coming to the front, as was indicated at the recent joint conference, in Detroit, between representatives of the manufacturers and the Associated General Contractors of America. The discussion above referred to tells the story from the manufacturer's point of view. At a later date it may be desirable to hear the contractor's side of the case. Any one with anything to say on this general subject, whether he be manufacturer, contractor or engineer, is invited to participate. A thorough airing of the views of all parties concerned cannot help but improve present conditions.

Broadcasting Practice

IN OUR issue of Dec. 14, we criticised the repeated announcement of the names of the Radio Corporation of America and the Westinghouse Electric and Manufacturing Co. during the broadcasting of a meeting of the American Society of Mechanical Engineers. We suggested that it might have been possible that the broadcasting companies required these repeated announcements of their names as one of the conditions of broadcasting the meeting. The Westinghouse company informs us that it lays down no such condition, but that it suggests, for the information of the hearers, that the code designation of the transmitting station be repeated at convenient intervals. Broadcasting experience has indicated the desirability of such practice.

Asphalt Inspection

ASPHALT plant inspection methods are outlined in rather remarkable detail in an article by Prof. W. J. Emmons in this issue. It is not often perhaps that so close control as is here demanded is found in practice. Indeed it is often contended that more than general watchfulness is not warranted when, as is commonly the case, a maintenance guarantee clause is written into the contract. With a clause of this kind in

force the contractor naturally resents exacting control of plant operation. Indeed, to regulate his mixtures and then demand that he guarantee their behavior and life over a term of years is unqualifiedly unfair. Retention of the maintenance guarantee clause in paving contracts precludes as a matter of mere justice plant inspection so detailed and exacting. In respect to the relative scientific merit of the two practices there would seem to be little doubt. Good plant inspection and control is a far more scientific and sure way of securing good asphalt mixtures than is any guarantee clause that can be enforced in practice. Another advantage is that it gives the engineer records with which he can do something to interpret service failures. On the whole, probably the cost of plant inspection is no greater than the charge which the contractor makes for risk in signing a maintenance guarantee. Whatever it may reasonably cost, it is worth the price as the only sure way of obtaining what the engineer specifies and the public pays for.

Optimism at Indianapolis

OPTIMISM prevails in the editorial sanctum of the Indianapolis *Commercial*. The burden of an editorial head "Public Service" printed Dec. 17 is that both the city officials of Indianapolis and the members of the State Legislature are being confronted by a demand from the public for better results than are now being given for their tax dollars. "Sooner or later," says the *Commercial*, "the inefficient public servant will be turned out. Officials with their ear to the ground—or in more euphemistic terms 'the wise public official' who wishes to continue in office—will not overlook the fact that more and more the tax-paying public is demanding for every dollar expended an honest dollar of return." Although this does not credit public servants with high ideals yet basically the *Commercial* is sound. If better public service comes it will be because of an insistent, persistent and intelligent demand from citizens and tax-payers. This alone is not enough. The public must show its willingness, once its needs have been formulated and agreed, to entrust the planning and execution of its work to technically trained men, reasonably paid, free from political interference and sure of their positions during good behavior and efficient service.

One Element of Progress

AS REFLECTIONS on engineering progress come upon the mind at the turn of the year, the large achievements engage attention, and the progress made in better utilization of materials and effort is overlooked. It is that element of progress which is found in routine activities and is therefore unobtrusive. Yet it is the principal, ever-present objective of the engineer and of those who work with him, though doubtless subconscious and unrecognized in most of us. In seeking continually for elimination of waste and truer adaptation of material to service, he carries his art forward to that perfection on which new creative achievement can be based. This tendency is found in all branches of the constructive arts; in production, by the seeking for greater uniformity or better controlled diversity of product; in marketing and standardization, where culling is transformed into grading and new uses are found for the remnants which existing markets do not absorb; and in engineering design.

What Is a "Sales Engineer"?

AMONG the letters published in this issue is a protest against the term "sales engineer". Our correspondent contends that it is an anomaly, that the ethics of selling and of engineering practice are incompatible, and that those engineers who perpetuate the term to describe the salesman who has engineering training or who sells an engineering product are performing a disservice to their profession.

We sympathize with Mr. Bedell. And if we limit the correct use of the word "engineer," as he has done, to describing those whose occupation is to supply disinterested technical knowledge and skill for the service of others, the soundness of his contention is obvious. He is correct again when he ascribes the growth of the practice largely to the manufacturers' efforts to capitalize the general respect for the term "engineer" and to invest with a certain prestige the men he sends out to sell his goods. And it is just this promiscuous appropriation of the name that is largely responsible for the difficulty in setting up and maintaining high professional standards in engineering practice.

In seconding Mr. Bedell's plea that use of the term "sales engineer" should be discouraged by engineers and their professional societies, we are not unmindful of certain related circumstances which have contributed to the growth of the practice and which must be remembered when we try to check it. One of these is the traditionally loose application of the word "engineer" which unfortunately has not enjoyed the limitation Mr. Bedell has placed upon it. Often it is used less to define a vocation than to describe a type of training. Then again, specialization both in training and in vocation has brought about the use of many qualifying adjectives; and this may have had something to do with the readiness of engineers themselves to accept "sales engineers" as just another variety. But neither of these circumstances can justify the use of the name "engineer" to describe any vocation in which an engineering graduate may happen to find himself.

Furthermore, it is true that not all manufacturers who employ "sales engineers" do it for the sake of window dressing. Some sales engineers are in fact not salesmen at all in the sense of booking orders. Some of them are employed to advise prospective or actual customers as to technical questions involved in a sale or to present technical considerations that may influence a sale. The value of such advice is not in question here—the prospect or the customer knows with whom he is dealing and can use it as he may see fit. This, to be sure, is not a professional relationship, but it is a technical relationship and can scarcely be included under the head of salesmanship. Perhaps a title other than "sales engineer" may fit more accurately; but when the individual is an engineer by training and engaged in a technical activity, it is easy to understand how this practice could have grown up without intention to mislead or to exploit the engineer's title. Frequently, indeed, it is the engineer employed on such work who is most insistent upon a title that will retain him in the ranks of the engineers despite the commercial flavor of his work.

Into Mr. Bedell's comment on sales and professional ethics no invidious comparison should be read. He assumes no "holier-than-thou" attitude. He simply states a fact. The salesman is frankly an advocate. The engineer—in the restricted sense—must be more

of a judge. The advocate, in whatever sphere, has a code of ethics by which the worthy are guided. The judicial officer likewise has his code. Each must be judged by his loyalty to his own code, and to judge either by the code of the other would be decidely unfair. There is no question as to one being better or higher; they are based upon radically different relationships.

In the interest of higher professional standards in engineering, the whole broad question opened up by Mr. Bedell deserves discussion. The principle involved is not confined to the "sales engineer." What of the "contracting engineer"? Is it not involved here also? Several material questions leap to mind; doubtless there are others. What do most of the so-called sales engineers actually do? Do they render technical advice; or do they sell or promote sales? Is the term frequently applied to salesmen of little or no engineering training? Will not discouragement of the practice help us toward a more clear-cut definition of what we mean by "engineer"? Most pertinent of all perhaps: How do the professional engineering societies now rate experience as a "sales engineer" when estimating a candidate's qualification for membership?

Building for Permanence

LOOKING back over the changes in our practical arts during the past three or four decades one may discern a slow but continuous movement toward assuring longer life of their products. The civil engineer's art is no exception; it is affected just as are the others. We build, or try to build, more lasting works than in the pioneer days. The spirit of the frontier railroad, of the mining camp, of the aspiring young metropolis, is fast disappearing—even today but little is left—and its disappearance denotes a change in the purposes that control constructional planning. Standards of merit have been modified; our valuation of what the builder produces has been rearranged to accord a recognized place to permanence.

The causes of the change are obvious. The important thing to note is that our altered attitude concerns almost everything that the civil engineer plans and constructs. Some generations ago, none but the water-supply engineer thought it worth while to plan far into the future; one may suspect that the general excellence of the country's water service traces back to this early perception of long-time values. On the other hand, the men who planned roads, railroads, bridges and buildings hardly looked beyond their present. They could not afford to plan more farseeingly, perhaps, or they were too busy with the task of building quickly.

Much waste followed in the train of these old-time practices. Loss by fire, by decay and by many kinds of obsolescence has borne heavily upon us and has taught us much. We have been learning step by step that it is not profitable to continue to do as we did in the years of mushroom growth. The present-day demand is unmistakably for permanence.

But the situation is in a way characterized by the term "demand." Permanence is a commercial demand, not an ideal that serves the planner's inspiration and therefore embodied in his work. The market asks for substantial, reasonably long-lived results, and the builder adjusts his planning to suit this demand. He endeavors to provide permanence by computing and designing—and in a measure, he succeeds—but he does not raise permanence to the rank of a controlling ideal, co-ordinate with suitability and service-excellence. Under these conditions can permanence have its full and proper influence upon our art?

To make the change in view more tangible, we may take bridge practice of thirty or forty years ago, which typified the mushroom-growth stage, and then take the present-day practice, when bridge money is spent almost lavishly. In the earlier period bridges were bought for the day's usefulness only, with price as the highest consideration and with vision bounded by the term of office of the town or county commissioners. There has been a revolution since then. The revolution in traffic conditions has brought it about. But whether there has been essential change in the bridge-builder's own spirit of working is open to grave doubt. To a great extent we still build bridges for the need of the day only—let tomorrow take care of itself!

Changes in building construction are of similar meaning. Mercantile building has advanced far toward being established on a standard of permanence, largely, however, through the dictates of fire protection rather than the thought of planning for permanence. We are not yet prepared to think of buildings remaining in service and being truly serviceable for many generations. And so, while we have built many structures of substantial materials, they were planned for short-time service and in time will clutter up our cities with antiquated buildings, monumental they may be, but hindrances to progress. There is steady advance however, in this field of commercial buildings and gradually there grows a conscious conception of the ideal of permanence.

Not so in the field of dwellings. We have grown out of the shack-town period of the Chicago conflagration, but we do not yet strive for permanence in the fullest sense. Nowhere are houses planned and built to be lived in as homes for long decades. The zoning movement may operate to improve the conditions responsible for this fact, but its influence can not yet be forecast. As matters stand today, our dwelling-house construction remains poor and ephemeral, as much so in the case of the planned house of the well-to-do as in that of the carpentered homes of the masses. Therefore we rebuild and will continue to rebuild every twenty-five years, until a more conscientious spirit comes into control and the planner strives to make each brick and each joist a thing that will serve its full purpose far on into the indefinite future.

In utilitarian engineering construction the conditions of past, present and future are quite parallel to those outlined. Examination of any individual field will illustrate the transition from building for a decade to building for a quarter century or so, and the steady movement toward building for the unlimited future. In each field, too, it may be seen that planning of enduring worth is more likely to result if the planner is inspired with a profound belief that his construction will and must endure. The great bridge cannot spring from a brain filled with the thought that thirty or forty or forty-five years will see the end of its life. It will be great only if there is wrought into every detail the belief that it will serve forever.

This is the coming spirit of all the engineering arts. The engineers of the pioneer era built well, no doubt, for their day of uncertain and speculative development but the conditions of those days have disappeared Future needs will be met truly only if permanence becomes the ideal of all planning and building.

Foundation and Framing Design of Colfax Power Station

Structure Characterized by Simplicity—Concrete Mat Foundation on Gravel—Column Loads Distributed by Reinforced-Concrete Walls—Special Retaining Wall and Sea Wall Held by Ties—Stack Towers

By M. E. Thomas
Structural Engineer, Dwight P. Robinson & Co., Inc.

COLFAX STATION, recently completed, is a mine-mouth superpower plant situated on the Allegheny River about 15 miles from the center of Pittsburgh and only one mile from the Harwick coal mine, which supplies it. It is the most recent addition to the "Duquesne Ring," a 66,000-volt loop which encircles Pittsburgh. The ultimate capacity of the station is 300,000 kw., made up of five 60,000-kw. units. The size is limited only by the supply of condensing water available from the Allegheny River. While there are no radical departures from general practice, the methods of construction and general layout represent a combination of some of the best ideas in power-plant engineering.

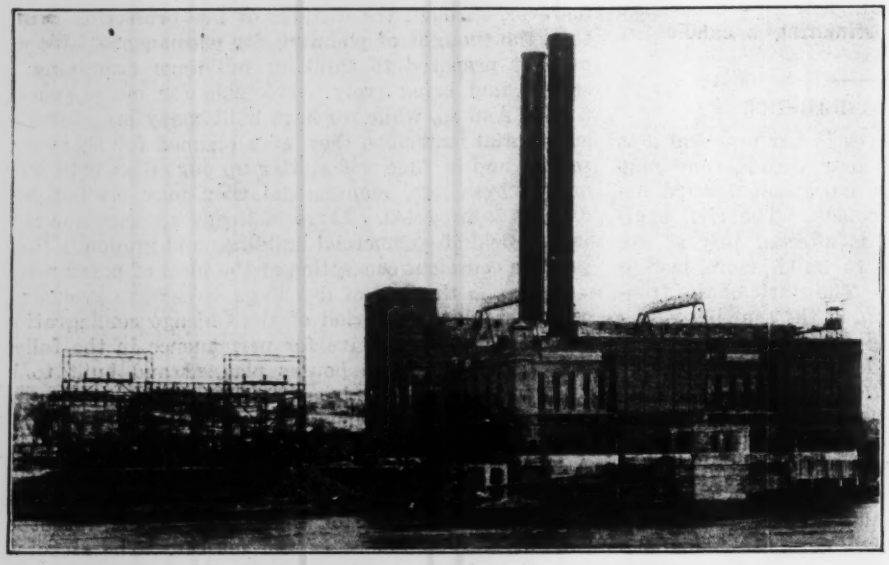


FIG. 1—LOOKING NORTH AT COMPLETED COLFAX STATION
Outdoor switching station at left. Intake screen well at middle of sea wall. Ultimate station capacity is 300,000 kw., half of which is provided for by the present building. The right-hand end wall is removable, for future extension.

The structural features, in common with other details of the plant, are interesting because of the simplicity with which they have been worked out. The framework of the station is steel. The foundation is of box type, in which the basement walls serve as distributing girders to distribute the column loads to the footings, these latter being either continuous mats or spread wall footings, according to local requirements. The general profile of the foundation was controlled largely by the depth to firm bearing soil, a compact sand and gravel stratum.

Boiler Room Foundation—The load from the boiler room columns is distributed by continuous transverse reinforced-concrete walls reinforced as beams, extending from the north side of the building to the wall adjoining the turbine room. These walls are 3 ft. thick and vary in depth from 10 ft. 3 in. at the north side to 25 ft. at the south side. The variations in depth, made in horizontal steps, bring the foundations down to the underlying gravel and sand, which slopes from the north side of the property down to the river bed. The wall load is distributed to the soil by reinforced-concrete footings, which in common with other parts of the station foundation were proportioned for a soil loading of 3 to 4 tons per square foot. On the north side all of the transverse foundation walls are tied together by a deep reinforced-concrete beam which forms the foundation for the exterior wall. On the south side they are similarly connected by the longitudinal wall under the columns between the boiler and turbine rooms; this wall is 4 ft. thick and is about 30 ft. high above top of turbine-room basement mat.

A reinforced-concrete slab construction supported on top of the foundations forms the boiler-room basement floor at El. 754.

Turbine Room Foundation—The turbine room basement is 253 ft. 6 in. long, 80 ft. wide and 29 ft. 3 in. deep, and is designed to contain the foundations, condensers, etc., for the two turbine generator units. Its north and south walls, each 4 ft. thick and 30 ft. high, distribute the crane and roof column loads to the foundation mat, which forms the floor of the basement. The east and west ends are closed by retaining walls which also form the foundations for the walls of the building. The east wall, to provide for future extension, was constructed of vertical I-beams with brick arches between, tied back to deadmen to take the earth pressure.

The turbine room basement floor being below the pool level of the river is designed to resist the upward hydrostatic head of about 30 ft. (extreme low water is about El. 721, while maximum high water is 754) and is waterproofed over the entire area including part of the side walls. The basement floor therefore consists of a reinforced-concrete mat generally 6 ft. thick, except over the area adjacent to the turbine foundations, where it is increased to 8 ft. 9 in. to accommodate air ducts and tanks.

On the south side the main wall is carried in its full thickness of 4 ft. down to a depth of 14 ft. 7 in. below the bottom of the concrete mat. This wall forms the south side of the intake tunnel, 14 ft. 9 in. wide and 13 ft. 1 in. deep, which runs longitudinally under

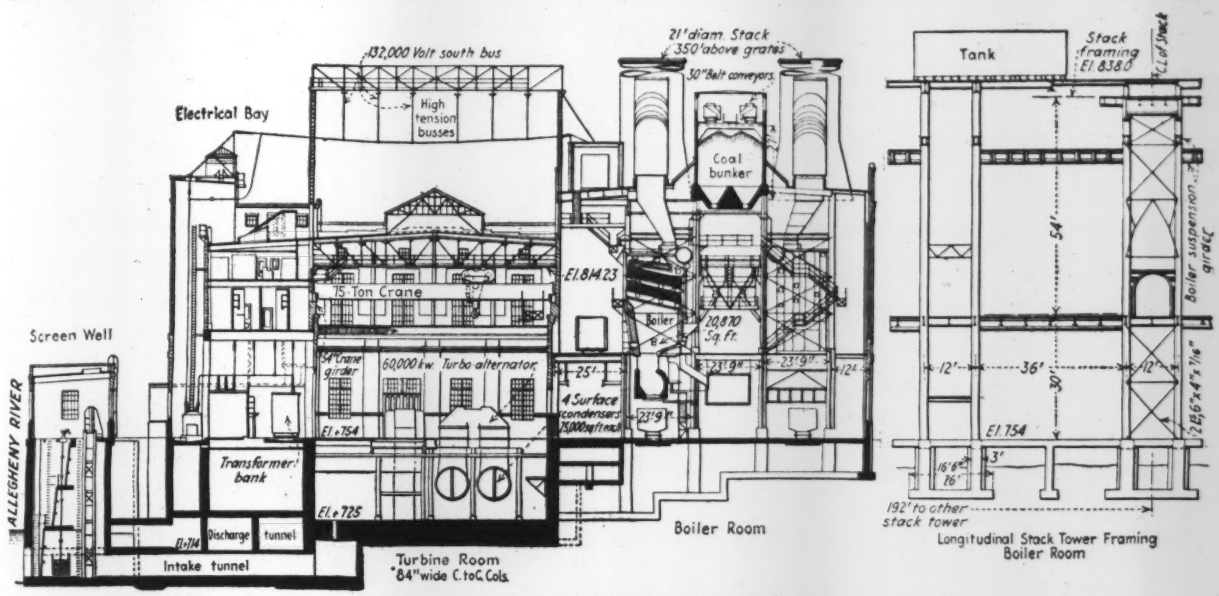


FIG. 2—TYPICAL CROSS-SECTION OF STATION, ALLEGHENY RIVER AT LEFT (SOUTH)

the turbine-room mat. The tunnel is 210 ft. long and is divided by a wall near the center, each part supplying the circulating water to the condensers of one unit by means of three suction pipes through the roof of the tunnel, and each part connected by a transverse tunnel under the discharge tunnel to the screen well.

Electrical Bay Foundations—Under the entire electrical bay is placed the discharge tunnel, designed for a capacity to provide for the future extensions, since it connects with the discharge to the river at its west end. This tunnel, 12 ft. deep by 45 ft. wide, is divided by two longitudinal concrete walls provided with openings at intervals to cross-connect. Its roof forms the floor of the electrical bay basement.

From the west end of the building the discharge tunnel is continued at an angle of about 45 deg. to the axis of the building to a point back of the harbor line, where it discharges into the river. Provision has been made for the future extension of the discharge tunnel, back of and parallel with a future sea wall at the harbor line, and to discharge into the river several hundred feet farther downstream.

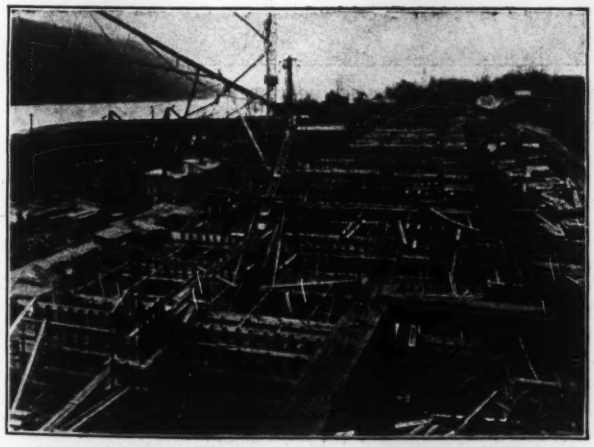


FIG. 3—FORMS FOR BOILER-ROOM FOUNDATION
Cross-walls distribute column loads to mat foundation.

The transformer-room floor consists of heavy reinforced-concrete beams, running transversely and spanning between the longitudinal foundation walls, with reinforced-concrete floor slabs.

Screen Well—The screen well is placed with the south

FIG. 4—REINFORCING OF MAT UNDER TURBINE ROOM

side on the harbor line at about the center of the present electrical bay. It is 44 ft. long and 32 ft. 8 in. wide, and is divided by a transverse vertical concrete wall into two independent units, each supplying the circulating water for one turbine unit. On the north side it connects with the intake tunnels by means of two transverse concrete tunnels, each 8 ft. x 12 ft. 6 in., passing under the discharge tunnels. On the south side the two wells are connected with the river by four openings each 7 ft. 3 in. wide and 10 ft. high, whose lower edge is flush with the bottom of the well.

Two 8 x 12½-ft. transverse tunnels connected with the discharge tunnels are placed directly over the two transverse intake tunnels, the four tunnels forming one construction. These two tunnels run under the electrical bay to the back of the screen well and are connected with the screen well back of the trash racks by openings 5 ft. square controlled by a valve to bypass the discharge water into the intake.

Sea Wall—A sea wall about 50 ft. high extends along

the harbor line, flush with the south side of the screen well. It is of reinforced concrete, 3 ft. 6 in. thick at ground surface and about 6 ft. thick at the bottom, where it rests on a concrete foundation 10 ft. wide and from 5 to 8 ft. deep. The lateral thrust from the earth pressure is taken by reinforced-concrete ties from the sea wall to the building, an upper row near the top and a lower row about one-third of the height from the bottom. The ties are spaced horizontally about 12 ft. apart. Considerable economy results from this type of construction as compared with a self-supporting wall of the same height.

Superstructure—The superstructure generally is a self-supporting structural steel frame with steel girders and beams supporting reinforced-concrete slabs for all floors and roof. The walls are generally of brick, except some special walls of reinforced concrete and the east (extension) end wall, which is of hollow tile construction.

The boiler room is about 350 ft. x 108 ft. between column centers and 87 ft. high from the basement floor level to the low point of the roof.

Between each group of four boilers on both the north and south sides the four columns are braced together from top to bottom with diagonal bracing, forming four braced towers, 12 ft. x 23 ft. 9 in., which support the stacks and carry the wind stresses to the foundation. The lower sections of most of these stack columns carry a load of over 1,500,000 lb. Steel I-beam grillages distribute the column loads to the concrete foundation walls. Anchorage is provided by four 2¾-in. anchor bolts 4½ ft. long.

Eighty-four feet above the basement floor the base of the steel stacks are supported by the stack base framing. A system of girders forms approximately two squares, one within the other, between which 24-in. I-beams are framed at distances of 2 to 3 ft., the space between being filled with concrete. This forms a steel and concrete mat upon which the steel stack rests. The interior square is floored with a reinforced-concrete slab. The stack is anchored to the mat by means of twenty-eight 2¾-in. bolts passing through pipe sleeves in the concrete to pairs of 10-in. channels which distribute the upward load to the bottom flanges of the 24-in. beams.

Stacks—The stacks are self-supporting brick-lined steel stacks, 21 ft. 9 in. in diameter inside of the shell and 271 ft. high from the base, or 355 ft. high above the ground. From 30 ft. above the base the stack flares out to a diameter of 28 ft. at the base, where heavy angle seats and stiffeners provide connections for the anchor bolts. The breeching connections for the flues are on opposite sides of the stack. The lining consists of 4½-in. hollow firebrick blocks supported by horizontal angles

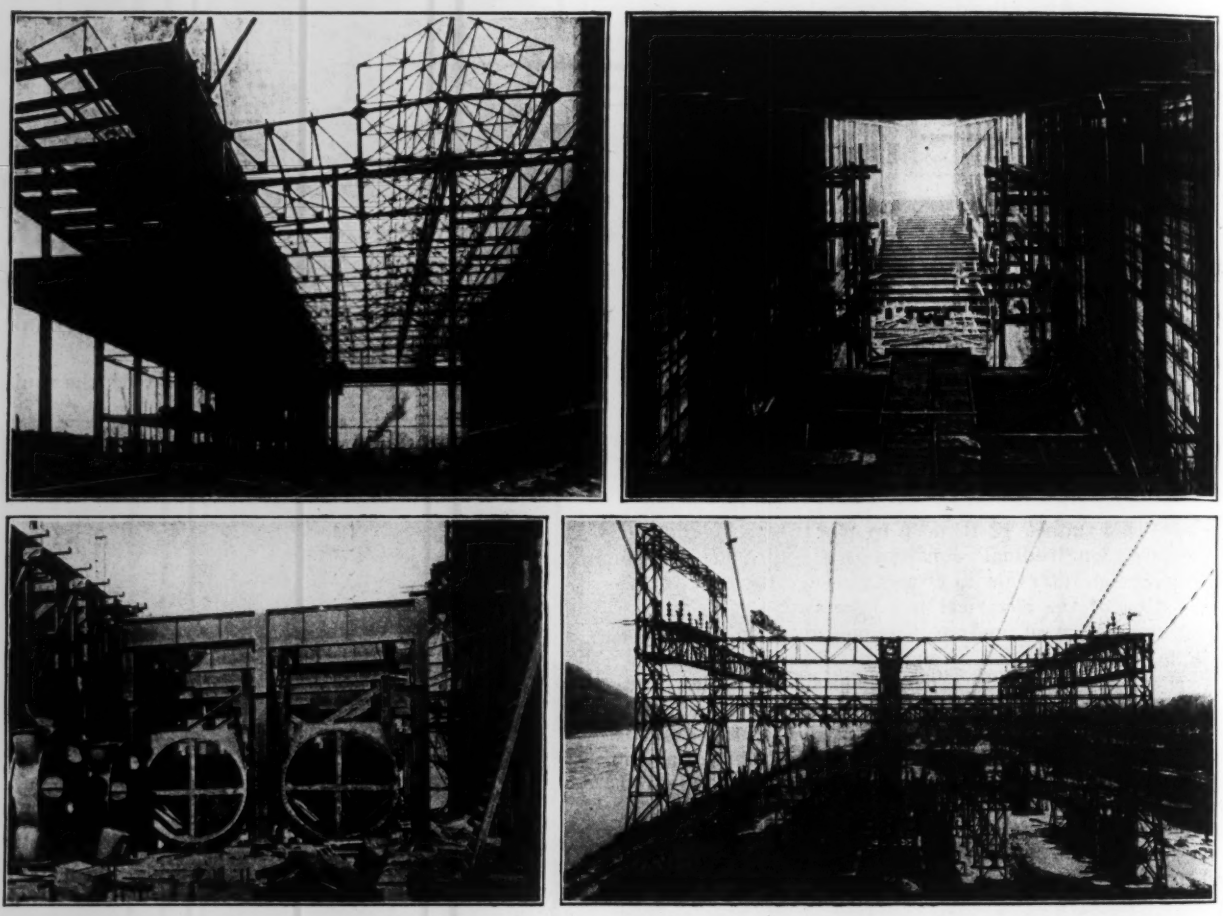


FIG. 5—FRAMING FEATURES OF COLFAX STATION, A MINE-MOUTH POWER HOUSE

Upper left, turbine room frame, boiler room at right.
Lower left, steel foundation for 60,000-kw. turbine unit.
Upper right, reinforcement and forms of coal bunker.
Lower right, outdoor switching station.

riveted to the shell at intervals of about 10 ft.

Coal Bunkers—The main coal bunker, over the boiler room, is of reinforced concrete and is 22 ft. 9 in. wide and 28 ft. 9 in. deep inside from top of conveyor floor. Its capacity is 10 tons per lineal foot. The 12-in. side walls embed vertical 8-in. beams, and are designed to act as girders to carry the entire weight of the bunker and coal to the steel columns without the aid of the structural steel. The side walls also take the lateral thrust of the coal and are tied together by reinforced-concrete beams. The reinforced-concrete bottom is of suspended type. Cinder-concrete crickets form pockets to the coal spouts.

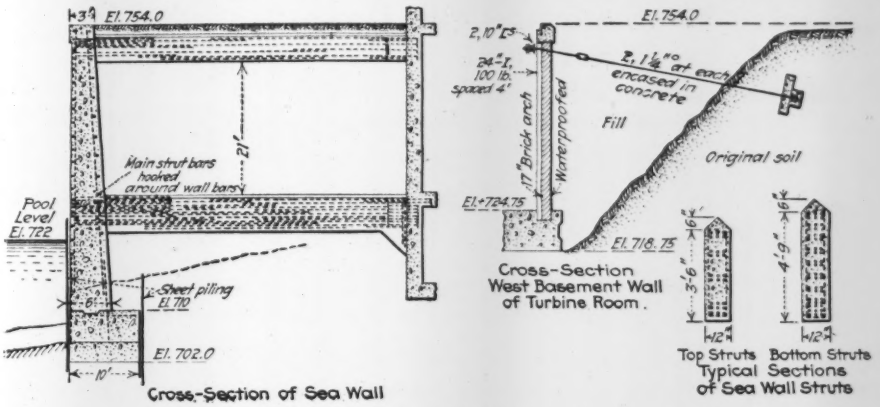


FIG. 7—SPECIAL SEA-WALL CONSTRUCTION

At the west end of the boiler room is a coal tower, whose main floor, on the level of the boiler room floor, is connected with the coal trestle and carries track stringers and rails continuous with those of the trestle. Directly under these tracks are two reinforced-concrete coal hoppers of 150 tons capacity each. The upper part of the tower contains employees' quarters and conveying machinery.

Turbine Room—The turbine room is about 254 x 84 ft. wide center to center of columns, and is roofed with steel trusses 60 ft. above the floor. A monitor and skylight 34 ft. wide run the length of the turbine room.

The turbines are supported on structural steel foundations extending to the turbine room floor level, El. 754. The turbine room floor consists of a concrete slab covered with 9 x 9-in. Welsh quarry tile, supported by a steel frame resting on steel columns and the concrete foundation walls. Except for the space between the high and low pressure turbines, where the floor is supported by the turbine foundation, the entire floor is kept free from the turbine so as to prevent transmission of the vibration of the turbines to the floor. Between the main units an open well about 25 x 50 ft. in the floor provides for lowering transformers and heavy machinery parts to the basement floor for repairs.

The interior side walls for a distance of 9 ft. above the floor are faced with white and gray speckled enameled brick with bull nose brick at corners, and a 10-in. black slate base above the tile cove. Above the enameled brick the walls are light buff Kittanning face brick.

The electrical bay is of steel-frame construction, with concrete floor slabs made thick enough to enclose the numerous electrical conduits embedded therein. The exterior walls and most of the interior walls are of brick, but concrete interior walls were used where it was necessary to carry conduits.

On the south side of each high tension bay, a group of six high tension brick shafts 12 ft. square extends from the turbine room floor level to a distance of 23 ft. above the electrical bay roof, where the conductors connect to the bus-bar structure on the roof.

The station was designed and built for the Duquesne Light Co. by Dwight P. Robinson & Co., Inc.

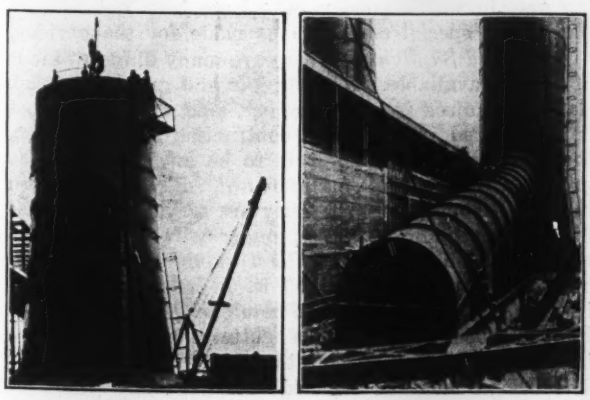


FIG. 6—22-FT. DIAMETER STACK, WITH SMOKE FLUE

Belated Settlement of an Old Aqueduct

BY FREDERIC I. WINSLOW
Division Engineer, Metropolitan District Commission, Framingham, Mass.

IN OCTOBER, 1920, a considerable settlement occurred in the principal thoroughfare leading from Natick to South Natick, Mass. At first it was supposed to be an ordinary settlement, caused by a leaky water main, which in this case happened to be a 10-in. cement-lined pipe and one likely to cause trouble, especially as there was a trolley car track in the street, with a fair amount of traffic.

After being filled in, and a further settlement occurring within a few days, it was ascertained that the settlement had occurred directly over the Badger Hill tunnel of the Sudbury Aqueduct, built in 1875. The extrados at this point were about 28 ft. from the surface of the street, and the point of settlement turned out to be 50 ft. from the beginning of the tunnel. As the water in the aqueduct appeared slightly discolored when sampled about 2,000 ft. away, the aqueduct was drawn down and entered. It was found that the settlement was directly over a number of "weepers" placed on the side of the aqueduct to prevent undue pressure from water from the hill. In all, about 50 cu.yd. of material, mainly gravel, were placed in the cavity. No further settlement has occurred.

Apparently the timbering used nearly fifty years ago had so decayed as to cause the dropping of the earth above, as there was probably a large amount of timber at this point.

Maintenance Engineering in Large Industrial Plants

Organization and Work of Department for Inspection and Upkeep of Buildings, Equipment, Yards, Tracks and Roadways

By Samuel E. Bird
Manager, Construction Department, Sears, Roebuck & Co., Chicago

MAINTENANCE AND REPAIR of buildings and other property at large industrial and manufacturing plants and public institutions is a continuous work which involves a great number of varied details and must be carried out systematically under expert management in order to keep the several structures in condition for economic service and for the safety and comfort of the employees or occupants. To detect and remedy troubles, solve problems, select materials and plan and supervise the work is truly within the field of the engineer. It is the purpose of this paper to show the scope and importance of the maintenance department rather than to give a technical discussion of the various classes and items of the work.

As examples of the problems which come to the engineer of plant maintenance the following may be mentioned: (1) The best materials for tuck-pointing settlement cracks in walls and at window joints, as well as the best time of the year and conditions for this work; (2) preventing dry rot; (3) preventing steel corrosion; (4) the installation of various kinds of expansion joints to take care of settlement, expansion and contraction, this applying especially in connection with concrete work and roads; (5) methods of waterproofing skylights, parapets and fire-walls; (6) the preparation of report forms covering building and machinery maintenance, the latter including elevators and motor trucks.

In large industrial plants and public institutions it is customary to have building superintendents or construction departments. Even in smaller plants, someone is detailed to look after the maintenance of buildings and to take care of repairs and replacements. Where a department has charge of building (architectural) as well as machinery (mechanical) maintenance, it should have as its head a man with training in architectural construction as well as with some knowledge of mechanical construction. A college education along mechanical or architectural engineering lines is a great help, as the theoretical knowledge enables the practical side of the work to be more easily grasped. On the other hand, some of the best construction maintenance men have been educated in the building field.

Much useful information may be gained from the study of catalogs, pamphlets and other literature sent out by manufacturers of equipment and building materials, but the maintenance engineer must be able to analyze and make proper selection. Any practical experience obtained from handling building operations in the field will prove valuable to a man taking charge of the maintenance of either large or small plants.

Building Inspection — Maintenance should include building inspections at regular intervals, with the findings tabulated and recorded on uniform blanks having divisions covering all parts of the structures; such as roofs, skylights, floors, columns, windows, stairs, foundations and outside walls. These blanks should have suitable file headings and should be kept in a filing cabinet, so that when repairs are made the items may be checked from the inspection records. The form of inspection blank will be determined largely by the type of building, whether of fireproof, semi-fireproof, steel, concrete, heavy mill construction or ordinary lumber construction.

In large cities such buildings are also subject to an annual inspection by the city, usually under the building department and subject to the building commissioner's approval. Among many other items this city inspection takes particular note of sanitation, light, fire and floor load conditions.

When new buildings or alterations or additions are under consideration the maintenance engineer has an opportunity to point out the type of construction most suitable for the purpose. He should have in mind the maintenance required for the various types, considering also the overhead, first cost and annual depreciation. If the operation to be carried on in the building is one demanding constant changes, especially in floor construction (as in the case of rearrangement of machinery of various types) this item should be given close attention. For both existing and new buildings the maintenance engineer must study their preservation, whether they are of concrete, wood or steel construction or a combination of the three.

Floors—The market is full of preparations for hardening cement floors and making them dustless. The maintenance engineer should analyze and study these; he must try them out and find the best adapted for his particular needs. Keeping concrete floors well surfaced is another problem. Where the traffic is light a good application of cement paint will overcome ordinary difficulties and prevent wear as well as dust. Where such floors are subject to heavy traffic, it may be necessary to give them a hardening or wax treatment, or if the traffic is too heavy for these treatments the difficulty of excessive wear may have to be overcome by the installation of an asphalt mastic aisle or other space where the wear is greatest.

In the cleaning of floors, care must be taken that no solutions containing a large amount of lye or other injurious materials are used. A good soap will usually serve for cement floors, but if this is not effective a proper solution must be devised for removing the dirt without injury to the floor. The patching of worn cement floors has been a difficult task and an interesting one, in which good results have been obtained by the use of special compositions made for the purpose.

Roofs and Skylights—There are many different kinds of roofing available. Asphalt, tar and gravel, built-up, slate, galvanized iron, tin, copper, zinc, etc. Each must be considered in regard to contraction and expansion, the conditions to which it is to be subjected and the probable charges for maintenance. Skylights are an important consideration. They are of various designs: flat, sawtooth, hipped, etc.; many with stationary as well as movable portions. Some skylights are of enormous size, running over 500 ft. in length and 100 ft. in width. These must be equipped with expansion joints, proper condensation gutters, conductors, etc., if a large amount of maintenance is to be overcome. The design must be selected also with due regard to the requirements for light, ventilation and heating.

One of the greatest problems is in keeping the skylights waterproof, since their leaking is one source of great damage to property in course of manufacture or in storage. Regular inspections of the expansion joint sections, calking the glass with elastic roofing cement under the cap sheets, and keeping the condensation gutters and drain gutters clean and well painted will overcome most of the trouble. Much of the difficulty with metal gutters at the base of skylights has been overcome by covering the metal with an elastic coating applied on a suitable membrane, such as burlap. This coating allows for the expansion of the gutters but also holds any seam tight which may be strained under expansion or contraction.

Paint and Preservatives—For preservation of building surfaces, paint when rightly applied is one of the best materials. When wrongly applied it may result in loss of time, money and energy. In this day of substitutions, some of which are very good and some not so good, it is advisable to study and analyze the various materials offered before applying them. For wood preservatives much information is obtainable from current literature and the catalogs of various marketed materials. The application of varnish and other wall decorative coatings is an item in maintenance of office sections, taking into consideration conditions of dust and smoke before adopting the various coatings. All such work should be done under careful specifications.

Timber Columns—In large buildings of mill construction, a problem of maintenance as well as a hazard exists in taking care of badly checked or warped wooden columns. In some older buildings such columns have had bolts put through them, but the bolt holes weaken the columns and in many instances under the writer's notice they have aided rather than prevented the checking. A much better method is to reinforce the columns by means of strong steel bands having a snug fit. Before the bands are applied, the cracked portion of the column should be pulled together with a clamping device. Wood screws with countersunk heads hold the bands in place in case of shrinkage of the timber. This construction avoids the objectionable feature of projecting bolts or screws.

Railway and Trucking Facilities—In enlargement or revision of plants the maintenance engineer must consider the convenient handling of materials and their delivery and shipment by rail or truck. This must provide for future expansion and will include the arrangement of tracks, driveways and platforms and the provision of cranes or other handling devices. At large plants he may have charge not only of buildings and machinery equipment, but of grounds and exterior parts of the property, such as roads, sidewalks, railroad tracks and switch tracks. He must be familiar with paving materials and be able to select good contractors and obtain proper bids for construction. In selecting the material, whether asphalt, brick, macadam or concrete, he must keep in mind the initial cost and the maintenance charge. Railroad maintenance in large yards is a task in itself.

Platforms and runways afford many problems. In small plants these structures are floored usually with plank. If exposed to the weather this planking should be laid with open spaces to afford ventilation. Where the traffic on the platforms is very heavy and where they are not exposed to the weather, wood blocks have been used to advantage. But with wood flooring exposed to the weather and having steel plates fastened to the blocks to facilitate trucking or reduce wear, there has been extended dry rot, resulting in heavy maintenance expense. A better flooring for such exposed platforms carrying heavy traffic would be asphaltic mastic of such composition as to meet the local conditions of weather and loads. Copper flashing will eliminate the chance of leakage due to shrinkage where this asphalt coating comes in contact with buildings.

Mechanical Handling of Materials—Machinery and appliances for the conveying, hoisting and handling of material may come under the supervision of the maintenance engineer. This equipment may include elevators, chain or belt conveyors, chain hoists, and inclined or spiral chutes. The maintenance item is greatly reduced if this equipment is made of standardized parts of simple design and if the manufacturer is easily accessible for repairs. In connection with material handling, the plant layout must be considered from the standpoint of continuous handling of raw materials to the finished stock, as well as the handling of materials received or shipped by railway, highway or waterway. Where large numbers of motor trucks are operated there must be a system of reports and records of service, mileage and maintenance and repair work.

Maintenance of elevators, machinery equipment and motor trucks should be handled as carefully and systematically as that of the buildings. The maintenance department usually has charge of the design of machinery guards, and in the last few years no movement has progressed faster than the safety idea. Closely allied to this is the work in regard to sanitation, comfort facilities, lighting and ventilation.

Plant Fixtures—Another branch of work taken care of by most maintenance and construction departments is the provision of merchandise fixtures, such as racks and bins. These may be of steel or wood, permanent or temporary, and stationary or collapsible. They must accommodate the merchandise conveniently without loss of space or undue overloading.

Insurance—Building insurance is sometimes carried and kept record of by the building department, which thus tries to keep the buildings and plant in such shape as to obtain the lowest possible insurance rates. Many concerns carry special kinds of insurance such as that on plate glass. In plants where fire prevention work is not handled by a special department it affords another activity for the maintenance engineer. Much information as to this line of work may be obtained from the local fire insurance companies, city fire departments or board of underwriters.

The elimination of waste must not be overlooked. By proper management much material from alterations and additions can be utilized, but to secure its best use there must be a systematic record covering such material, and sorting and storing facilities must be provided.

Care of Leased Buildings—Many plants find it necessary to rent additional buildings for storage space. The maintenance engineer should be consulted before the leases are closed, as the maintenance of rented buildings becomes a very expensive item where the tenant maintains the building during the life of the lease. An inspection of the premises should also be made at the time the lease is made, this inspection

being covered by written reports showing the exact conditions or being written into the lease so that no misunderstanding will arise at a later date relative to these maintenance items.

Contract and Force Account Work—In a department having charge of maintenance there should be a division to handle estimates, bids or proposals, as well as the letting of contracts. For keeping records this division should have filing equipment of the inclosed drawer type, with indexes and tickler system. Provision should be made for the filing of orders under construction, as well as for files for all completed orders carrying with them guarantees or important data.

Contracts carrying guarantees, as in the case of roofing, should be kept in the file until after the guarantee expires, the date of expiration being kept in a tickler. The contract should be filed also under the contractor's name, so that proper inspections and examinations can be made before the guarantee expires. Where it is hard to obtain outside labor for repairs and alterations a special department may be organized embracing the various trades, such as carpenters, painters, machinists, millwrights and sheet metal workers. It is customary for the construction department to hire these men, directly or through the employment department.

A drafting department is essential in connection with maintenance work. In most establishments this need not be large, but it should have the proper organization to produce results without loss of time or waste of energy. There should be equipment for filing drawings and making blueprints. In this department should be kept records of the various sewer, water, gas and other piping and conduit systems. A catalog file should be included in the office equipment, for which a sectional bookcase will be convenient. For this department the judgment of the engineer is needed in selecting the draftsmen and managing the work.

Column Strength of Single Angles

Tests of 170 Struts at Bureau of Standards—End Fixation Factors Ranged From 1.1 to 1.9 for Various Connections

COMPRESSION tests of single-angle steel struts made in 1917 by the Bureau of Standards but not reported until now (Technologic Paper 218) give new data on the strength of columns over an exceptionally wide range of slenderness—from length-ratio 50 to 350. The series included 170 separate angles, of sizes ranging from 1½ x 1½ x ⅛ in. to 6 x 6 x ¾ in., with over-all lengths ranging up to 23 ft. 3½ in. No effect of size of angle on column strength per square inch is noted in the report, but the tabulated results show a rather large range at all length-ratios, apparently due to variations in the grade of the steel. Thus, in one series of tests (Fig. 1) the range of maximum load for columns of length 100 was from 36,800 lb. per square inch for a 3 x 3 x ⅜-in. angle to 27,900 lb. per square inch for a 6 x 6 x ½-in. angle, although mill test reports gave practically identical properties for the two heats from which these angles were rolled.

Plots of the test results are shown in Figs. 1 and 2.

Fig. 1 gives the individual test results for a series in which both legs of the angle were attached to end fittings by means of two or more bolts at each end. The heavy line is drawn through the average results at the several length ratios represented. The dot and

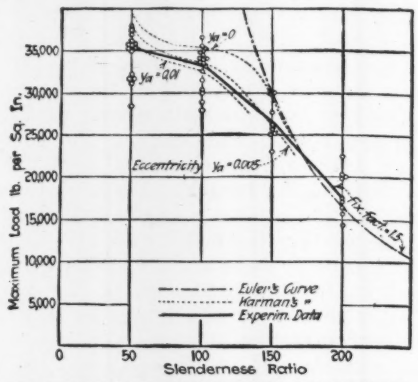


FIG. 1—RESULTS OF ONE SERIES OF SINGLE-ANGLE COLUMN TESTS

Angles 3 x 3 x ⅜ in. to 6 x 6 x ¾ in., 3 ft. 2 in. to 20 ft. 3 in. long over all; ends connected by two or more bolts in each leg.

dash curve at the right represents the Euler formula computed for a "fixation factor" of 1.5. This factor represents the ratio of actual length of strut to the length of the equivalent round-end column as estimated from the test results. This particular series extended only to length-ratio 200. Throughout the range it exhibits a variation in strength of 7,000 to 10,000 lb. per square inch, or 28 to 45 per cent of average strength.

All the 170 tests are brought together in Fig. 2, but here only averages are plotted. The upper heavy curve represents angles with flat (square) ends, not fastened.

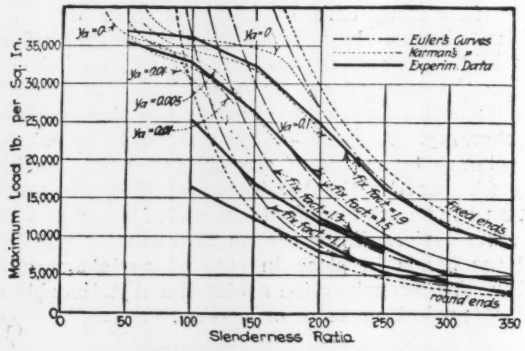


FIG. 2. AVERAGE RESULTS OF ALL TESTS

Total number of tests 170; angles 1½ x 1½ x ⅛ in. to 6 x 6 x ¾ in., tested in lengths up to 23 ft. 3½ in. over all. Strength of steel by mill test coupons 58,000 to 65,000 ultimate, 36,000 to 39,000 yield point (one result 47,000), 26 to 30 per cent elongation, 50 to 59% reduction of area. Upper heavy curve, test with flat ends; next lower curve, connection by two or more bolts in each leg at each end; next pair of curves, connection by two bolts at each end; lowest curves, one-bolt connection at each end.

The next lower curve represents angles attached by both legs to end fittings, with two or more bolts in each leg at each end. The next pair is for angles connected to end fittings by one bolt in each leg or by two bolts in one leg, the results differing inappreciably. The two lower curves are for angles attached by only one bolt at each end; in the tests represented by the left-hand curve the ends were "folded," that is, one leg was flattened down upon the other and the bolt passed through the double thickness. The fixation factors, noted on the curves, 1.9 to 1.1, are deduced by the authors of the report, A. H. Stang and L. R. Strickenberg, as being the proper ones for the several conditions of ends tested, according to the agreement of the result with theoretical curves for these factors.

It is stated that formulas of the Rankine type do not fit the results, while the Karman formula (represented by the various dotted curves in Figs. 1 and 2 but not quoted) fits well.

Comparison of the relative strengths of the struts and their relative initial eccentricities, which latter were inferred from the midpoint deflections at 4/9 of the Euler load, are presented in tabular form as a study of the effect of initial eccentricity. The authors state that in nearly every case the struts with the larger eccentricity showed the lower strength.

Miami Conservancy Work Completed

Dams and River Improvement Work Are Completed and Enterprise Is Being Changed Over to a Maintenance Basis

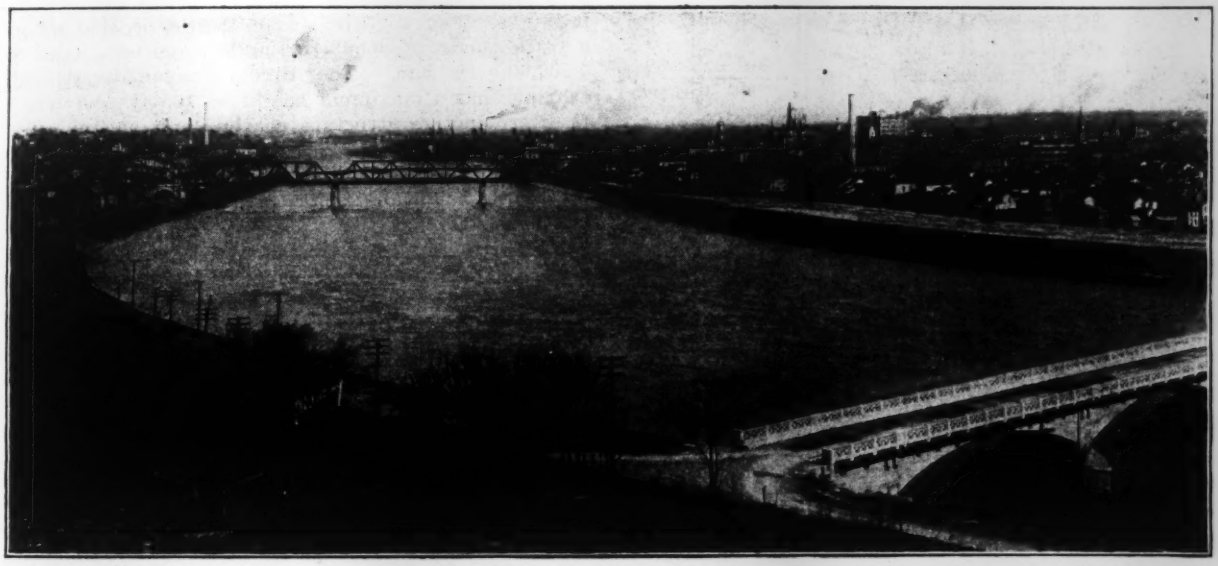
THE $30,000,000 flood control project of the Miami Conservancy District is at the point of completion, according to a recent report from Charles H. Paul, chief engineer. All five of the dams are in the hands of caretakers and are being operated on a maintenance basis. River improvement and levee work at the nine cities and towns throughout the valley is either entirely completed or nearly so. In fact the only uncompleted construction jobs are the channel work at Hamilton, which will be entirely finished soon after the first of the year; the completion of a highway bridge at Troy, which will be open to traffic about Jan. 1; a small amount of levee construction at Piqua, which will be finished about the same time; and the construction of a water-works and electric light plant at Tippecanoe City, necessitated by the fact that the present plant comes within the limits of one of the retarding basins.

A large part of the extensive construction plant has been released, and is being overhauled and sold. As practically all of the work was done by the District's own forces, there is a large amount of plant and equipment to be disposed of, and this is one of the active features of the District's work at present.

As the whole job will soon be on a maintenance basis, the organization of the maintenance forces is now proceeding rapidly. Caretakers and patrolmen are being appointed, for duty at all points where the flood control works have been constructed, and a plan for systematic inspection and reports is being worked out, with the idea of keeping the works up to 100 per cent efficiency at all times, ready for a flood whenever one may occur.

An unusual problem is presented here, in that the floods against which these works will be of most benefit are not of annual occurrence but may occur only once or twice in a lifetime, and it is necessary to keep alive and up to the mark a project that may not be called upon for maximum service for many years to come. The matter of keeping tuned up, under such conditions, is much more difficult than where a real test occurs at least as often as once a year.

The accompanying photograph shows the result of some of the river improvement work. At Dayton more than 2,000,000 cu.yd. of material have been removed from the river channel. The safe capacity formerly was about 75,000 sec.-ft. and has been increased to 120,000 sec.-ft. At Hamilton the channel excavation, which amounted to about the same quantity, together with some raising and strengthening of levees and extensive paving of slopes gives a safe channel capacity of 200,000 sec.-ft. Formerly it was below 100,000 sec.ft.



MIAMI RIVER AT HAMILTON AS IMPROVED—ORIGINAL CHANNEL CAPACITY DOUBLED BY REGULATION

Amount of Lumber Used for Boxes

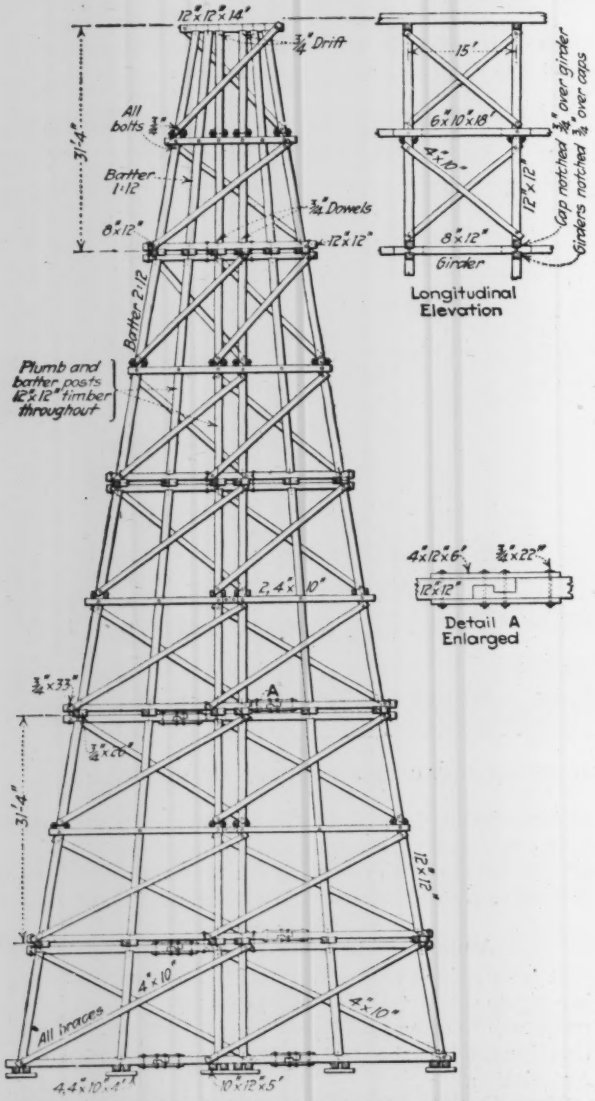
It is calculated that about 15 per cent of all the lumber produced in the United States is consumed in the manufacture of wooden boxes, according to the information bureau of the National Lumber Manufacturers' Association.

More than two-thirds of the low grade product of the North Carolina pine region is ordinarily used for box purposes. Nearly 50 per cent of loblolly or North Carolina pine goes into boxes; 35 per cent of shortleaf pine in the same territory; about 8 per cent of longleaf pine and a smaller percentage of the other softwoods in that region.

Heavy Trestlework Required on New Logging Railroad

Line 38¼ Miles Long in Oregon Used 4,500,000 Ft. B.M. in Five Trestles—Cableway Erected High Bents in 30-Ft. Sections

A STANDARD-GAGE railroad 38½ miles long is now being constructed to the northwest of Portland, Ore., to tap heavy stands of fir timber that are to be cut in the near future. The line was originally begun as a private enterprise but construction has recently been taken over and is being completed by the Spokane, Portland Seattle R.R. Co. Rails have been laid over about 23 miles of the new line and construction is progressing rapidly. In addition to the railroad a mill



TYPICAL CONSTRUCTION OF FRAMED BENT TRESTLES

is under construction at Vernonia, which is at milepost 22 on the new line, designed to cut 250,000 ft. b.m. per 8-hr. shift. Logs brought out over the new railroad will be delivered via the United Railways to a booming ground on Willamette Slough near Portland whence delivery to mills of the vicinity can be made by water.

The new railroad begins at Wilkesboro, Ore., the terminus of the United Railways, a subsidiary of the Spokane, Portland and Seattle system, and extends thence 32.6 miles to the Columbia-Clatsop County line. This much of the new railroad is to be a common carrier operated by a company formed for this purpose and known as the Portland, Astoria & Pacific R.R. Co. Beyond the county line the Oregon-American Lumber Co., which is constructing the mill at Vernonia, will operate the remaining 6 miles of track as a private logging road.

The new railroad has a maximum gradient of 2.3 per cent, compensated, a maximum curvature of 12 deg. up to the county line and 14 deg. for the 6 miles beyond. Eighty-five-pound rails are used throughout. There is only one tunnel, which is 1,143 ft. long, but trestles and bridges abound. In all there are forty-two stream or canyon crossings including thirty-five trestles or bridge-approaches aggregating 10,140 ft. in length, five bridges of 60-ft. span, five of 72-ft. span and two of 84-ft. span. All the bridges are Howe framed timber trusses.

The most notable construction feature of the new line is the trestlework. Five of the trestles located within a track length of about two miles required a total of 4,500,000 ft. b.m. The Brook Canyon trestle, for example, has a maximum height of 165 ft. and is 696 ft. long; another structure nearby, built entirely on a 12 deg. curve, is 605 ft. long and has a maximum height of 133 ft. The Ganzer Canyon trestle, 925 ft. long and reaching a height of 155 ft., required 1,100,000 ft. b.m. in its construction.

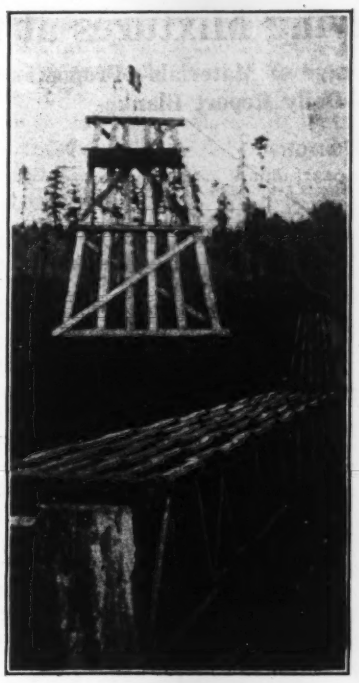
Timber for these five trestles was delivered to storage yards at the site well in advance of track laying operations by the use of old logging railroad spur lines which were rehabilitated for the purpose. In the case of three of these the old spur tracks actually passed through sites suitable for timber storage yards. In the other two cases short extensions of the old spurs were required. From the storage yards, which were all in the bottoms of the gorges crossed by the new line, inclined cableways delivered timbers to framing platforms at one end of the trestle site and at deck level.

The framing platform consisted of a plank floor large enough to accommodate one 30-ft. section when laid out flat. The location was selected so that the platform would be under both the main cableway spanning the gorge and the upper end of the incline cable from the timber storage yard. Timbers were handled on the platform by a locomotive crane. All boring was done with compressed air boring machines served from compressors on the steam donkey engines used for operating the cableways. As each section was finished it was immediately removed from the platform to make room for the next. With a little care in operating the cableway each section could be delivered to its exact location in the trestle.

The framing platform crew normally consisted of twenty-one men. This included, in addition to the men actually framing and assembling the sections, all labor required to move the timbers from the storage yard in the valley below and complete the sections on the platform ready for removal by the main cableway. The work of this crew, it was found, would just balance the work of an erection crew on the trestle consisting of seven men. Included in the latter were two main cable-

way operators and one "hooker on," leaving only four men continuously employed on the trestle. These four, in addition to fastening the sections that were delivered at the rate of about one every hour, placed the girders and braces and drifted or bolted them into place as required.

For this average crew of twenty-eight men the daily payroll was $182. When placing seven sections per eight-hour day which was a common rate of progress, the labor cost on timber in place was about $8 per thousand feet board measure. On some days a much more rapid rate of progress was attained. In the case of the trestle located on a 12 deg. curve the main cable was provided with two anchorages a short distance apart on one side of the gorge so the arrangement of the cable end, in plan, would take the form of the letter "Y." With this plan and by paying out or taking up slack at these anchorages from time to time as required, the main cable was shifted so as to permit of delivering sections in place on all parts of the trestle. The main cable was 1¼ in. in diameter.

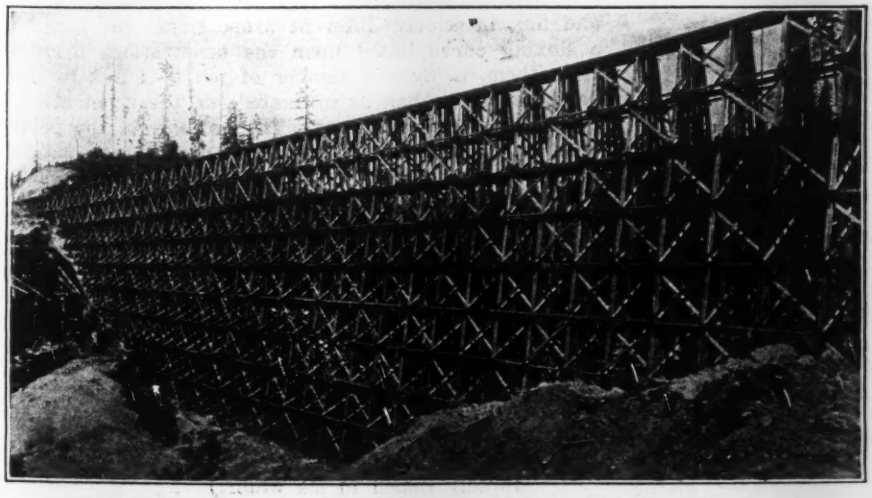


FRAMED SECTION EN ROUTE TO POSITION

The dark object near the top of the section is a 2 x 12-ft. log used as a counterweight.

The location of the old logging road spurs was found convenient only in the case of the five large trestles. For bridge and trestlework farther along the line timbers went in from the nearest Southern Pacific R.R. siding on motor trucks which made the latter part of their haul over the graded roadbed. Thus the trestles were completed well ahead of the tracklaying crews and despite the numerous crossings and heavy trestlework there were no delays in track construction on this account.

The design of the trestles as well as the initial work of construction was under the direction of George Scoggin, chief engineer and F. I. Roth, assistant engineer, Portland, Astoria & Pacific R.R. On Nov. 1, 1921, the work was taken over by the Spokane, Portland & Seattle R.R. Co. and since then has been carried on under the direction of A. J. Witchel, chief engineer, and G. V. Lintner, assistant engineer, of that company. Construction of all trestles and bridges is being carried out by J. F. Clarkson & Co., Portland, subcontractors. The Utah Construction Co. holds the general contract.



GENERAL VIEW OF GANZER CANYON TRESTLE

This structure has a length of 925 ft., a maximum height of 155 ft. and contains 1,100,000 ft. b.m. of lumber.

Operation of a Drainage Pumping Plant

PERFORMANCE and operating cost of a drainage pumping plant on the Yuma project of the U. S. Reclamation Service as given by D. C. McConaughy, office engineer, in the February issue of the *Reclamation Record*, are summarized in the accompanying table. Two screw pumps, a 36-in. and a 30-in., driven by 100-and 75-hp. oil engines, have capacities of 60 and 30 sec.-ft. respectively. Provision is made for two more 36-in. units. The lift is variable, partly on account of changing water level and partly because the pumps are operated normally only a portion of each day, so that water accumulates in the forebay. In 1921, the plant averaged 8½ hours operation daily, with an average lift of 9.25 ft. During a 6-weeks' flood stage in the Colorado River, the head reached a maximum of 14.2 ft. and the maximum daily operation was 22 hours. A chief operator and one assistant constitute the regular force, with a second assistant during the high water period. This force will be sufficient to operate the plant when additional units are installed.

PERFORMANCE OF DRAINAGE PUMPING PLANT

	Cost	Per Cent of Total
Operation: Labor	$4,176.74	37.5
Fuel	3,143.54	28.2
Lubricants	811.36	7.3
Repairs to machinery: Labor	435.76	3.9
Materials and supplies	1,360.00	12.2
Minor equipment, repairs and supplies	864.56	7.8
Minor miscellaneous expense	16.65	0.1
Equipment	330.00	3.0
Total	11,139.61	100.0
Per acre-foot	0.437	....
Per foot acre-foot	0.044	....
	Pump Performance	
Average run per day	100-hp., 9.1 hr.; 75-hp., 9.3 hr.	
Average lift (both pumps)	9.9 ft.	
Water pumped: acre feet	25,520	
Foot acre feet	253,170	
Fuel oil, per acre foot	1.34 gal	
Per foot acre foot	0.13 gal.	

How To Inspect Asphalt Paving Mixtures at the Plant

Testing Outfit Required—Inspection, Testing and Storage of Materials—Proportioning the Materials—Methods of Sampling—Daily Report Blank

By W. J. Emmons

Professor of Highway Engineering, Agricultural and Mechanical College of Texas, College Station, Tex.

PLANT inspection is one of the essential details of asphalt pavement construction and, if intelligently carried on, is a measure of true economy. Given an inspector endowed with common sense, tact and a knowledge of the principles of asphaltic construction, the engineer may feel assured that the component materials and the resulting product will conform to his specifications and that in its uniformity of composition the mixture will almost certainly be far superior to one whose proportioning is left to the contractor's forces.

Field Laboratory and Equipment—A field laboratory should be established at the paving plant. It may be located in any convenient structure which is well lighted and in which a work bench is available. Preferably it should contain a window commanding a view of the mixer platform in order that the inspector may be in constant touch with operations there. The following apparatus should be supplied the inspector:

1—Penetrometer, field size, with standard needle.
1—Balance and set of weights, capacity to not less than 100 grams and sensitive to 0.1 gram, for sand tests.
1—Balance and set of weights, capacity to 1,000 grams and sensitive to 1 gram, for sieve tests upon coarse aggregates.
1—Set of sand sieves—10-, 40-, 80-, and 200-mesh sizes.
1—Set of stone screens—¼-, ½-, ¾-, 1-, 1¼-, 1½-in. diameter holes or those necessitated by the maximum size of aggregate to be used.
2—Armored asphalt thermometers reading to 600° F.
1—Trowel.
24—Tin cans, approximately 2¼ in. in diameter by 1⅛ in. in depth for penetration tests upon asphalt.
1—Ten-quart bucket for cooling penetration specimens.
1—Small dipper or ladle for sampling asphalt.
1—Wood paddle for the pat test upon sheet asphalt mixtures.
1—Set of specifications.
A supply of stout unglazed paper for the pat test.
A supply of report forms.

Duties of Inspector—The duties of the inspector should be as follows:

1. To test materials as received and during use and to see that they are not mishandled during storage.
2. To oversee the combination of materials, including the checking of proportions, accuracy of scales, and regulation of temperatures.
3. To secure samples of materials and the mixture as produced.
4. To submit daily reports to the engineer, giving full information regarding the operation of the plant.
5. To secure data regarding the origin and the costs of materials and the cost of plant operation.

Asphalt—Ordinarily the inspector is required to test the asphalt for penetration only, and it is common practice to allow an approved brand to be used, provided the consistency is correct, without awaiting the results of complete tests from the laboratory.

A penetration test should be made upon shipments of asphalt as soon as the car is steamed and upon any which may have been left over from the previous day's operations. The asphaltic cement is kept hot by means of direct fire or steam and is agitated by steam or air. High temperatures (above 325 deg. F. for most asphalts) and violent agitation both tend to reduce the penetration and may even change the characteristics of the asphalt if carried to extremes.

When a refined asphalt and a flux are to be combined into an asphaltic cement, the inspector must determine the combination required to yield the desired consistency. This is most easily accomplished by preparing three or four mixtures of the refined asphalt and flux in widely different proportions and plotting a fluxing curve based upon the penetrations derived from them, using the number of parts of flux to 100 parts refined asphalt as ordinates and the penetrations at 77 deg. F., as abscissas. The ordinate of the point upon the curve corresponding to the desired penetration will give the parts flux to the 100 parts refined asphalt which it is necessary to use.

In order that accurate and consistent results may be obtained in the penetration test, the following rules should be strictly observed:

1. Fill the small can with hot asphalt and set aside for one-half hour in order that it may cool to air temperature. Be sure that the sample is free from air bubbles and that no dust from the plant can get into it.
2. Immerse the sample in water at exactly 77 deg. F. for one hour. (Sample should never be rapidly cooled in ice water.)
3. Perform the test with sample under water held accurately at 77 deg. F.

RULES FOR INSPECTORS

1. An inspector with a chip on his shoulder has a hard time getting what he wants.

2. Except to the mixing crew, when quick action is demanded, give no direct instructions to the laborers—make known your desires to the foreman.

3. Do not discuss plant problems and difficulties while off the job—a twisted version of your account may reach the engineer or contractor and cause embarrassment.

4. Do not make unsolicited suggestions regarding the operation of the plant unless it is for the good of the pavement mixture.

5. Make tests upon new materials promptly, decide carefully whether they should be accepted or rejected, and do not reverse your decision without very good reason.

6. Be fair and consistent in your rulings. Remember that the contractor as well as the engineer has definite rights under the contract.

7. Get your daily reports in daily.

4. Specimens which have stood for more than three hours should be carefully reheated to about 325 deg. F., stirred and recooled under the conditions given above.
5. Take particular care that the needle is not allowed to rust or the point to become dulled. Stick it into a cork when it is not in use.
6. Wipe the needle with clean cloth between tests; never with oily or gasoline-soaked waste.

Sand—The sand supply should be watched by the inspector with extreme care, for upon its composition the success of the pavement largely depends. A general inspection should be made and samples for sieve analyses selected from all sand in storage piles as soon as the inspector reaches the plant. He should note the number of varieties, their individual uniformity and whether each is piled separately or is more or less mixed with other grades. This latter practice is very bad practice and should be guarded against. Subsequent shipments should be inspected and tested as soon as received to determine not only their suitability, but also whether they may be stored with the present stock or are of such different characteristics that they must be piled separately.

Samples must be taken so that they will be truly representative of the whole mass. This may best be accomplished while the sand is moist, as segregation of sizes is then avoided. The mixture of several handfuls, scraped from the vertical faces of holes dug into the pile at a number of points, constitutes a convenient method of sampling. The large sample should be taken to the laboratory, thoroughly mixed and reduced to the proper size for a sieve analysis by the quartering method. A 100-gram sample is sufficiently large for a sieve analysis, and if the material is dry the test may be run immediately. If the sand is moist the sample obtained by quartering should be a few grams heavy in order that it shall weigh not less than the 100 grams after drying. The 10-, 40-, 80- and 200-mesh sieves are generally used in making sieve analyses at the plant.

As the sand in most mixtures is a combination of two or more sands from the stockpiles, it is well to check the uniformity of feeding by frequent samples taken from the hot sand storage bin. A small frying pan or a wooden box with a short handle makes a convenient sampler. The sampler is taken at the time a batch is being drawn into the measuring box by passing the sampler back and forth through the stream. The first material flowing from the bin may not be representative and it is, therefore, better to delay taking the sample until a few seconds after the gate is opened. After cooling, the sample should be quartered to 100 grams and screened.

Stone screenings are sampled and tested by the same general methods outlined for sands. In the sieve analysis, however, sieves of larger sizes are used as required. To avoid excessive wear upon the fine mesh sieves, the sample is divided over the 10-mesh sieve, the proportions retained and passing noted, and separate analyses run upon each. The ordinary 100-gram sample is used for the finer portion, but 500 grams should be selected for the coarser. By multiplying the several component per cents constituting each sieve analysis by the respective per cents which the fine and coarse materials bear to the original sample of screenings, the sieve analyses of the parts finer and coarser than the 10-inch mesh sieve are proportionately reduced to per cent of the original sample.

Crushed Stone and Gravel—These materials, as they appear in the storage piles and shipments, should be inspected for freedom from weathered, or disintegrated particles and coatings of dirt.

It is difficult to sample large masses of coarse aggregate, especially if the sizes composing it are somewhat segregated. The best method is to go over the pile carefully, noting the presence or lack of uniformity, and take shovelsful from several locations in such a manner as to represent the composition of the whole as closely as possible. The sample so selected may weigh 40 or 50 lb. and should be collected in a large box or clean sack. After the sample is quartered down to 4,000 or 5,000 grams, a sieve analysis may be run by ordinary methods.

Grades of coarse aggregates, differentiated upon the basis of nature or test characteristics should be stored in separate stockpiles. The unloading of dirty or otherwise unsuitable aggregates should not be permitted.

Dust—The one test which the inspector is usually required to make upon material used as filler is that for fineness, or per cent passing the 200-mesh sieve. The dust may be received at the plant either in bulk or in sacks. In the former case it is only necessary for the inspector to collect small quantities from a number of different places in the mass to secure his sample. In the latter case small quantities should be taken from a dozen or more sacks. Once the sample is obtained, it should be quartered down to 50 grams and shaken over the 200-mesh sieve until virtually no dust falls upon a clean sheet of paper placed under it. The residue retained by the sieve is then weighed and the per cent passing computed.

Dust which becomes damp or wet during storage forms into lumps which do not break down in the process of mixing and such material is unsuitable for use as filler.

Proportioning Cold Aggregates—The uniformity of all asphaltic paving mixtures depends to a greater or lesser extent upon the care and accuracy with which the cold aggregates are fed into the plant. Clearly defined piles of the several materials should be located at the foot of the cold aggregate elevator with one or two laborers assigned to feed them systematically in simple proportions.

Sometimes the contractor sinks a box around the foot of the cold aggregate elevator, dumps into it alternate wheelbarrowsful of the several materials and assigns a single man, armed with a hoe, to the task of maintaining the feed. Such a practice seldom results in uniform aggregate at the mixer, since the materials are very likely to become segregated. The only conditions under which such proportioning should be permitted are those in which each batch is fed into the plant and delivered to the mixer as a unit, and in such cases the barrows should always be accurately filled to a level of known volume.

Proportioning the Hot Aggregates—From the dryer the heated aggregates are elevated to screens which separate the materials and deflect them into the stone and sand bins over the mixing platform. Segregation of sizes in these bins is one of the difficulties in the path of uniform proportioning and constitutes the

strongest objection to the use of a single storage bin when such stone and sand mixtures are being prepared. Holes in the partition between two adjacent bins or in the screens will result in a mixture of two classes of aggregate and entirely upset the scheme of proportioning. The same thing may occur in some plants from the too rapid feeding of any one cold material, the result being that it finally fills its bin and overflows into the next. The composition of aggregate showing a permanent and clearly recognizable mark. A second mark must be made showing the height reached by the combined aggregates after the stone has been placed on the sand. The box-man must be required always to draw the sand first and to level each material even with its mark by means of a short hoe.

The greatest care should be taken to insure the accuracy of the scales. Before work starts the inspector should check them by means of test weights or with

CITY OF BRYAN, TEXAS

10th Daily Report of Asphalt Plant Inspection

Street: *College Ave.* Location of Plant: *S. P. Siding* Date: [illegible]

Type of Const.: *2-in. Mod. Topeka* Foundation: *6-in. Concrete* Weather: *Fair* Temp. A.M.: [illegible]

Contractor: *Municipal Paving Co.* Type of Plant: *Peerless* Temp. P.M.: [illegible]

MATERIALS AND PROPORTIONS IN PAVEMENT

Materials	Origin or Brand	Proportions Of Feed	Batch Weights (Lbs)	Per Cent	Total Used (Tons)	In Stock (Tons)	Cost per Ton
Refined asphalt							
Flux							
Asphaltic cement	*Mexaco*		*43*	*8.6*	*5.16*	*50*	
Sand (*fine*)	*Brazos Sand Co.*	*1 pt.*	*208*	*41.6*	*12.48*	*100*	
Sand (*coarse*)	*Brazos Sand Co.*	*1 pt.*			*12.48*	*75*	
Dust (filler)	*Southern Lime Co.*		*41*	*8.2*	*4.92*	*50*	
Screenings	*Colorado Cr. Stone Co.*	*2 pts.*	*208*	*41.6*	*24.96*	*175*	
Crushed stone							
Gravel							
Total			*500*	*100.0*	*60.00*		

DAY'S PRODUCTION

Construction	No. of Batches	No. of Loads	Hours in Oper'n	Sq. Yds. Laid
Modified Topeka	*240*	*30*	*8*	*580*

PLANT OPERATING COSTS

Material	Origin	Am't. Used	Cost
Coal (tons)			
Fuel oil (gal.)			
Lub. oil (gal.)			

SAMPLES TO LABORATORY

Material	Origin	Am't. Rep't'd	Serial No.
Modified Topeka	*Daily plant sample spout*	*day's run*	*8*
Asphalt (Pen.)		*day's run*	*9*

Labor	No.	Hours	Total Hours	Rate of Pay
Foremen	*1*	*10*	*10*	
Engineers	*1*	*10*	*10*	
Skilled labor	*2*	*10*	*20*	
Unskilled labor	*6*	*10*	*60*	
Trucks	*5*	*10*	*50*	

MATERIALS TESTED AT PLANT

Material	*Sand Bin*	*Sand Bin*	*Sand Bin*	*Sand Bin*	*Sand Car*	*Sand Car*	*Scr'gs Car*		Penetrations No.	Penetrations Test
Sample from										
Per cent passing 200-mesh sieve	*3.0*	*2.8*	*2.0*	*3.0*	*6.8*	*0.3*	*2.0*		*1*	*50*
Per cent passing 80-mesh sieve	*24.0*	*25.6*	*12.0*	*26.0*	*50.0*	*6.7*	*1.2*		*2*	*52*
Per cent passing 40-mesh sieve	*42.8*	*40.0*	*46.8*	*41.3*	*39.2*	*49.0*	*2.8*		*3*	*52*
Per cent passing 10-mesh sieve	*29.7*	*30.6*	*37.2*	*29.4*	*4.0*	*40.0*	*14.7*		*4*	*51*
Per cent passing 4-mesh sieve	*0.5*	*1.0*	*2.0*	*0.3*		*4.0*	*43.3*		*5*	*50*
Per cent passing 2-mesh sieve							*36.0*			
Per cent passing ½-inch screen										
Per cent passing 1-inch screen										
Per cent passing 1¼-inch screen										
Per cent passing 1½-inch screen										
Per cent retained 1½-inch screen										
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*		Ave.	*51*

Remarks:—*Plant shut down 2 hrs. for repairs on elevator. Low 80-mesh at 1 P.M. due to poor feeding by new laboror.*

J. W. Brown, Inspector.

contamination with others should never be guessed at as a basis for the addition of bitumen, but the bins should be emptied and the trouble corrected before mixing is resumed.

The measurement of aggregates by volume is sometimes attempted, and, while not as easily controlled as measurements by weight, uniform results may be obtained provided the box-man can be impressed with the necessity for accuracy. The asphalt is always measured by weight and the volume of aggregates must be determined which will correspond to their proportions by weight in the mixture. The point to which this volume of sand fills the measuring box must be indicated by large rocks or sacks of cement previously weighed upon scales which may be found in express depots or elsewhere. After mixing begins whole loads should, if possible, be frequently weighed upon platform scales and checked back against the batch weights at the plant. Care should be taken that aggregate does not wedge under the free platform upon which the measuring box is mounted and all parts of the weighing apparatus should be cleaned daily. If the scales get out of order, mixing should be immediately suspended until repairs are made.

Unless the box-man is experienced and cool headed he will many times overrun his weights. This may

easily be a serious situation and he must be trained to work carefully. Sand requires approximately four times as much bitumen as does an equal weight of stone, and thus, if the routine amount of asphalt be added to an unbalanced aggregate, the mixture will be rich or lean, depending upon whether the stone or the sand is in excess.

Asphalt—The volume of a given weight of asphalt varies greatly with changes in its temperature and consequently this material is always proportioned by weight.

The asphalt bucket is suspended from a set of scales and these should be checked for accuracy as was suggested previously for those supporting the aggregate measuring box. The weights, both compensating for the tare weight of the bucket and representing the contents of the bucket, should be fitted with set-screws which will prevent them from being disturbed by the vibration of the plant or accidental blows.

The attention of the inspector should be given more or less constantly to the proportioning of the asphalt and particularly at certain critical periods. In the morning the bucket is clean and cold and retains a considerable proportion of the first batches as a coating on the bottom and sides. Succeeding batches continue to build up this layer until the bucket becomes thoroughly heated, when the adhering asphalt is gradually released. Finally an almost constant quantity is retained by the bucket for such period of time as the plant remains in continuous operation. It is clear, therefore, that in order to avoid a deficiency of bitumen in the first few batches and an excess in succeeding ones, the tare weight of the bucket must be almost constantly watched and the counter-balancing weight frequently adjusted.

Filler—Dust may be weighed with the other aggregate but is more likely to be blown away by the wind, especially if the mixing platform is not enclosed. Ordinarily, the weight of dust which one or more ordinary water buckets will hold is determined and the proper number of bucketsful added to each batch. As it is easy for the laborer only to partially fill the buckets or to forget exactly how many are required, the inspector should watch this detail carefully.

Regulation of Temperatures—Mixtures reaching the street should be hot enough to rake properly but not hot enough to permit the segregation of materials in this process or to injure the asphalt. Under ordinary summer temperatures outside limits for asphaltic concretes and sheet asphalt should be 225 deg. F. to 350 deg. F.

Of almost equal importance with the proper degree of temperature is the uniformity with which it is maintained. All asphalts suffer a decrease in penetration when heated, and the higher the temperature the greater will be the extent to which they will harden. Also hot mixtures compress to a greater degree than do cold ones. Thus extreme variations in temperature at the plant may seriously affect the serviceability of the pavement.

Constant attention must be given the rate of feeding cold aggregates and the fires under the dryer if uniform temperatures are to be maintained. When the plant starts in the morning, materials are fed in slowly, but nevertheless the first aggregate through the cold elevator, bins and measuring box may reach the mixer at too low a temperature to be properly mixed. By pushing the fires and feeding slowly, aggregate will soon come through at satisfactory temperatures and as soon as it does the rate of feeding should be increased. Otherwise the temperatures may swing to the other extreme and necessitate another delay until they can be lowered.

A method of reducing temperatures which are too high, is to increase the rate of feeding cold and damp aggregates and at the same time open the door of one or more of the fire boxes. Aggregate which is coming through at too high a temperature may, in some types of plants, be cooled by throwing cold sand into the heated aggregate as it falls out of the dryer.

Whenever it appears that aggregate is being received at improper temperatures, it should be held in the measuring box and tested despite the eagerness of the mixer crew to rush it through. Let the thermometer remain in the material until it ceases to rise. Remember that it is easier and less expensive to reject aggregates before rather than after the bitumen and dust have been added. In the former case they may be hauled back to the storage piles and used again later; in the latter case the batch is a total loss. It should seldom be necessary to reject a completed batch due to improper temperatures, although occasion to do so frequently arises due to blunders in proportioning on the part of the mixing crew.

Mixer and Conditions of Mixing—The mixer must be in good shape, all blades must be present, and, while long enough to prevent masses of partially mixed asphalt and aggregate from adhering to the sides of the mixer box, should not be long enough to wedge coarse particles. The blades should be so spaced and placed that the mixture is worked from both ends toward the center and the speed of rotation should be sufficient to churn the mass vigorously.

The aggregate, after being run into the mixer, should be turned for a few seconds in order to permit a uniform distribution of the filler before the asphalt is added. The asphaltic cement should be poured in slowly and uniformly over the full length of the mixer. The time of mixing should be extended somewhat beyond the instant at which the mixture appears uniformly black. At proper temperatures one minute for sheet asphalt and three-quarters of a minute for coarse graded mixtures is sufficient.

Asphaltic pavements should not be laid during a rain or on a wet base. As soon as rain starts to fall the inspector should direct that plant operations be stopped. If the precipitation is very light he may allow the last truck to proceed to the street and leave its disposition to the inspector there. Following light summer showers it is frequently possible to proceed with the work, but the inspector should await advices from the street before permitting the resumption of operations.

Samples of Materials and Mixtures—Samples of all new materials not conforming to those approved before the work is started should be sent to the engineer or laboratory, even though the inspector regards them as suitable and permits their use. Samples of aggregates should be taken by the methods outlined earlier in this article.

For proper control daily tests should be made upon the mixture for bitumen content and sieve analysis of the aggregate. The plant inspector should gradually

collect a sample for this purpose by taking a trowelful from each of a large number of batches during the day. It may be heated, mixed and quartered to the proper size at the end of the day's work. The proper sizes of samples for the several materials are as follows:

Sand, lb.	5
Screenings or stone passing a ½-in. screen, lb.	10
Coarse aggregate, lb.	25
Asphalt, qt.	1
Sheet asphalt wearing surface mixture, lb.	½
Topeka surface mixture, lb.	1
Binder or coarse graded asphaltic concrete, lb.	3

All samples should be numbered serially and further identified by reference to them in the inspector's report.

Inspector's Reports—The engineer must be kept fully informed regarding the progress of the work and conditions at the plant. The inspector is furnished with report forms for this purpose and it is very necessary that they be submitted daily. The reports should be numbered in series beginning with the day the inspector reaches the plant and continued (Sundays excluded) until the work is completed. Every detail of the plant operation and inspector's activities should be included. A specimen report is shown here, illustrating a day's operation upon a modified Topeka mixture.

Keeping Costs—Cost data are necessary in order to formulate accurate estimates and the inspector should collect detailed information concerning them. If possible, the costs of materials, bills of lading showing weights of materials, and the wages paid to labor should be obtained from the contractor. The quantities of fuel and lubricants used may be obtained from approximate weekly consumption.

New Outfall Sewer and Sewage-Works Progress at Los Angeles

A PROGRESS report on the outfall sewer and sewage works project of Los Angeles, Calif., for which $12,000,000 of bonds were voted on Aug. 29, shows that on Dec. 4 there had been built or put under contract 3.68 of the 7.41 miles of emergency relief sewer, that plans had been made or were well under way for the remainder of this sewer; plans were being made for a 3-m.g.d. emergency sewage-works near Culver City, consisting of storage reservoirs, pumping plant, Imhoff tanks and sludge beds, sprinkling filters and secondary tanks, these works to be enlarged as the flow in the relief sewer increases; plans were being made for a new ocean outlet at Hyperion, at the end of the existing trunk sewer, the new outfall to be of 60-in. cast iron and to extend about a mile into the ocean, to a water depth of some 54 ft. below mean sea level.

The emergency relief sewer from the present ocean outlet to the emergency sewage-works on Ballona Creek is designed for a capacity of 40 sec.-ft., to accommodate the excess dry-weather sewage flow of the next three years. For the upper 2.15 miles of this relief sewer, now built or under construction, there is being used 44-in. riveted steel pipe formerly used on the construction of the Los Angeles Aqueduct. For the remaining 5.26 miles of this sewer a contract was awarded on Nov. 29, specifying Ferguson's segmental block for 1.58 miles, and for the remaining 3.68 miles there is under consideration the same material with wood-stave pipe as an alternative for the upper end and for the lower end reinforced-concrete pipe lined with vitrified clay blocks, with wood-stave pipe as an alternative.

The construction work at Hyperion will be divided into three contracts: (1) The ocean outlet al[so] mentioned; (2) about 700,000 cu.yd. of grading f[or] sewage-works; (3) the sewage-works proper. [No] dates for letting these three contracts have not [been] fixed, but it is expected that the lettings will take pl[ace] and the sewage-works and the ocean outfall be pu[t in] use before the new outfall to the ocean is put u[nder] construction.

John A. Griffin is city engineer and W. T. Knowlt[on] engineer of sewers at Los Angeles.

Operator's Viewpoint of Canal and Structure Design

Irrigation System Efficiency and Maintenance Depends on Proper Layout—Experience on Valier Project Given

By George Ebner
Operation Engineer, The Valier-Montana Land and Water Co., Valier, Mont.

WITH the increasing importance of problems relating to irrigation operation and maintenance and the greater study being given them a review of many practices which have been shown advantageous are of value when new construction is planned or replacement or remodeling is necessary. Observations are given on the location of structures, silt problem, design to prevent or minimize slides, methods of handling weeds, alkali and preferences as to chutes, pipes or drops.

The main canal should be free from check gates which create orifice conditions and under no circumstances should two sets of orifice gates, without overflow, be used in a diversion structure. If it is necessary, and it often is, to check water into a lateral some flashboard arrangement is preferable, since it is impossible to check with gates under the varying flow of a main canal. A combination of gate and flashboard control is oftentimes an advantage. Generally a weir action control will cause less surge and wash downstream and result in less maintenance expense.

Unless exceptional conditions exist no lateral or service turnout should ever be placed above the main canal grade. Excessive checking is necessary and good service is not possible. Whenever the turnout or intake can be placed below canal grade the check can be eliminated.

In diversion structures where silt laden streams are encountered the surface water is taken into the canal; in other cases silt traps and wasteways are used to wash out the sand during flood seasons. However with many mountain streams the entire flow even in flood season is taken. When the creek has a fall of 10 ft. per mile and the canal 3 ft. it can be seen that all the silt load will be thrown into the canal. By raising the diversion weir and canal intake a backwater pond upstream will be formed where the creek can unload. This plan was used on the Birch Creek headworks, designed by C. E. Atwood, chief engineer of the Valier Project, and after four years' use no appreciable silt has reached the headgates or has entered the canal.

On side hill location where the bank has a tendency to slide, it is believed that a wide, shallow canal section is better than one deeper and narrower. The bank pressure is less and there is less head to cause seepage. Often this situation can be benefited by a parallel drain at the toe of the bank with sufficient outlets. Bond ditching under the embankment and rolling the fill material are of direct benefit. A preliminary investi-

gation may disclose a tendency to slide and make a lined section or bench fluming advisable. Pumping plants could have been built in some cases where distribution begins at no greater construction cost than that of the gravity canal and the pumping cost would not exceed the gravity section maintenance charge.

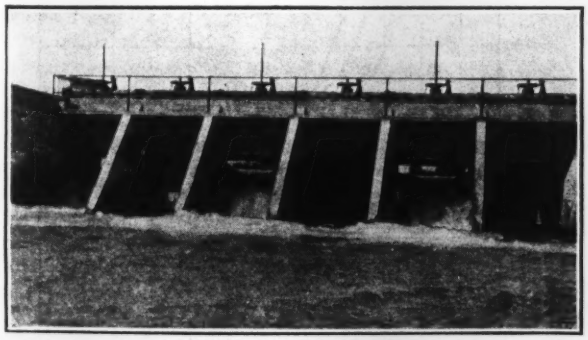
No canal should be permitted to cut and carry silt. With excessive silting portions of the canal may lose area so that to permit cleaning service must be interrupted every season. In maintenance work the construction of grade controls and drops will be found more economical than never ending silt cleaning. Too much importance cannot be attached to this point. The writer has in mind two canals of 400 and 500 sec.ft. capacity, slope of 0.004 and 18 and 20 miles length which after ten years are carrying their rated capacity without any silt cleaning at all.

Because of the growth of grass and weeds it is good practice to make small ditches of excess capacity. Cleaning is deferred and the yardage per station is light. Where moss grows an excess cross-section is needed in all canals to insure good delivery service.

Structures have been built which meet all hydraulic requirements but easily become clogged with weeds and thistles. This is true of baffles and of small openings below curtain walls. With a combined turnout and check the turnout is more likely to clog than it would were the check a short distance downstream. Of various measuring devices, weirs and Venturi flumes offer less obstruction than orifices.

Where alkali is present it is imperative that attention be given design, drainage and kind of material for initial or replacement structures. The cement gun is found profitable for repair work.

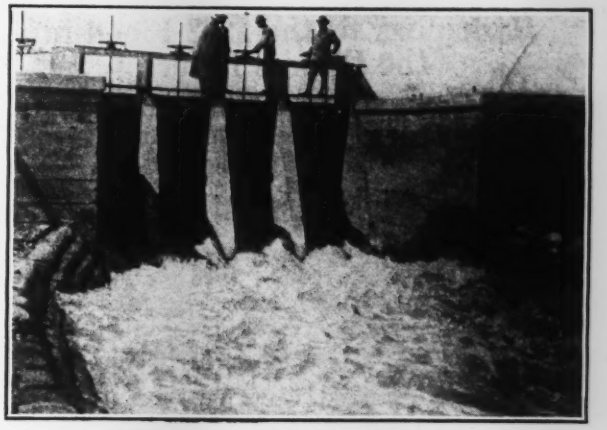
Wherever topography will permit their use open concrete chutes have been found more economical than pipe lines or a series of drops. It is axiomatic that all chutes should have transition intakes, computed cross-sections and be tile drained. Those built by the U. S. Reclamation Service are models in every respect. Metal chutes carrying silt-laden water are found to wear excessively under the high velocities created. The cost of a properly designed chute outlet is but slightly



WEIR TYPE OF INTAKE SHOWING LITTLE DISTURBANCE

greater than for the outlet of a single drop. Special attention is being given the hydraulic-jump type of outlet at the present time. In the design of all intakes to chutes, flumes and drops, care should be taken to maintain upstream in the canal the proper water depth and slope.

Remodeling a structure may increase its capacity or lower maintenance cost. On replacement structures



TURMOIL WITH ORIFICE GATES PASSING 250 SEC.-FT.
Disturbance so great sand bag revetment necessary to prevent erosion.

whenever the annual interest charge for new construction plus its annual maintenance is less than the present yearly maintenance, relocations or additional construction should be considered. For proper service and economy, the maintenance work should be kept up to requirements for no irrigation district can afford poor or frequently interrupted service.

The Proper Term for Water-Works Bonds

By Charles W. Sherman
Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

Conclusions of a paper read before the New England Water Works Association, Dec. 12.

1. The average life for a "typical" water-works plant in this country is about 50 years. It will rarely be less than this in individual cases, and may be as much as 60 years or more for some works.

2. Complete records of depreciation, including abandoned structures, of a number of water-works plants of considerable age show that the total accrued depreciation of the physical plant of such works is about 20 per cent of the cost. Departures from this mean are not great. Records of depreciation suffered by the plant still in service, modified by a suitable allowance for plant abandoned, confirm this as a reasonable figure.

3. The corresponding average age for works of 50 years' life is 20 years, leaving 30 years average remaining life. If the average useful life were 60 years instead of 50, the average age would be 27 years and the remaining life 33 years. Thirty years is a fair estimate of the remaining life of any water-works plant in normal condition, and therefore a proper term for which water-works bonds should run.

4. If the works have suffered a depreciation of 20 per cent, including abandoned property, there is a residual value of 80 per cent of cost of the physical plant. Water-works bonds may therefore be issued up to 80 per cent of the cost of the works.

5. Municipally-owned water-works should be self-supporting, and their financing should be on the same basis as that of private corporations.

6. The present Massachusetts law which limits bonds for the extension of municipally-owned water-works to 5-year terms is illogical and burdensome and should be repealed.

7. Special legislation for particular cases, made necessary by the existence of the five-year limit, is undesirable from every point of view.

8. Suitable control over municipal bonds for water-works purposes can be exercised by requiring the approval of the Public Utilities Commissioners in exactly the same way as for bonds of a private water company; and misuse of water revenues can be avoided by legislation limiting their uses to water-works purposes.

Hydrology of the 1922 Flood in the Illinois River

Maximum Stages Reached with Minimum Flow Due to Channel Restrictions by Levees—Long Period of Heavy Rainfall

By H. E. Grosbach
District Engineer, U. S. Geological Survey, Chicago

THE Illinois River flood of April, 1922, was notable in that the stages reached were the highest ever observed, although the flow was less than had been recorded within twenty years. This flood resulted from an unusually long continued period of rainfall. Precipitation occurred over the drainage basin on all except nine days of the period from March 10 to April 18. Fig. 1 shows basin and drainage area. For other notes on this flood see *Engineering News-Record*, May 11, p. 804.

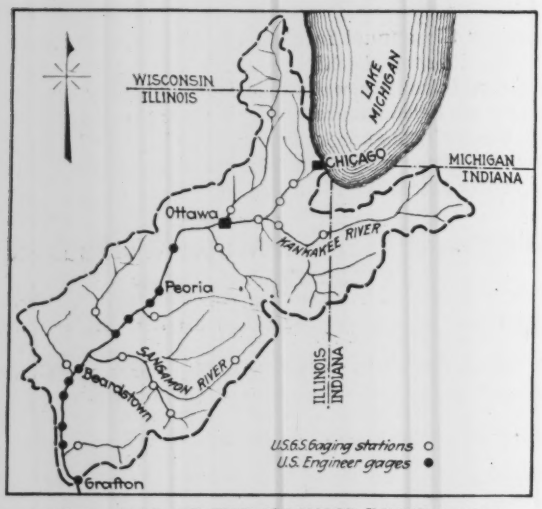


FIG. 1. MAP OF THE ILLINOIS RIVER BASIN

Daily average rainfall on different sections of the basin above Beardstown, computed from Weather Bureau records, is shown in Fig. 2. In this figure are shown also the daily discharges at Peoria and Beardstown for April, as determined from gage readings of the U. S. Engineers and discharge measurements by the U. S. Geological Survey, co-operating with the Illinois Division of Waterways and the U. S. Public Health Service. The discharge includes the flow of the Chicago drainage and sanitary canal, diverted from Lake Michigan.

Precipitation was heaviest in the drainage area of the Sangamon River, the largest tributary, where the average rainfall from March 10 to 14 was 3.0 in; March 19 to 20, 1.4 in.; March 24 to 31, 2.9 in.; and April 3 to 18, 5.4 in. The maximum 24-hour fall recorded was at Morrisonville in the Sangamon basin, and amounted to 4.4 in. The Sangamon was at high stages for several weeks reaching a maximum discharge of approximately 39,000 sec.-ft. at its mouth on April 14. Some tributaries from the north received much less rainfall and neither the Fox nor Spoon rivers reached flood stages. A maximum of 30,400 sec.-ft. was recorded on the Kankakee River at Custer Park, near its mouth.

Profiles of the maximum water stages in the lower section of the river for various floods are shown in Fig. 3. The flood of 1844 reached higher stages than any

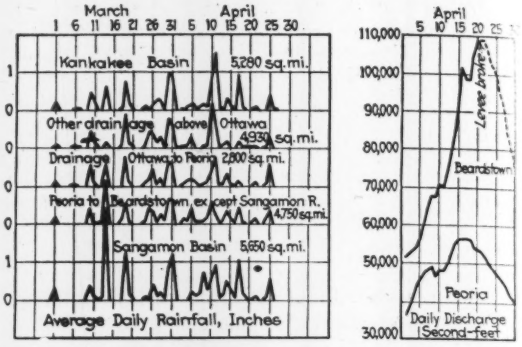


FIG. 2—DAILY AVERAGE RAINFALL AND DISCHARGE

previously observed since the Illinois Valley was settled. The elevations of that flood were determined by the U. S. Engineers from authentic high water marks.

The other profiles were drawn from gage readings by the U. S. Engineers. Maximum discharges are given below as indicated by the Geological Survey measurements except that the 1904 discharge at Beardstown was determined by the U. S. Engineers:

	1904	1913	1922
Peoria	70,000	55,000	56,600
Havana	80,000	.....	68,000
Beardstown	115,000	.....	109,000

It will be noted that the 1913 flood with practically the same stage and considerably less discharge at Peoria than recorded in 1904 rose to higher stages below Havana. No discharge measurements were made below Peoria in 1913. In 1922 the discharge at Peoria was considerably less than in 1904 and at Beardstown slightly less. The maximum stage in 1922, however, was 1.7 ft. above that in 1904 at Peoria, 2.5 ft. higher at

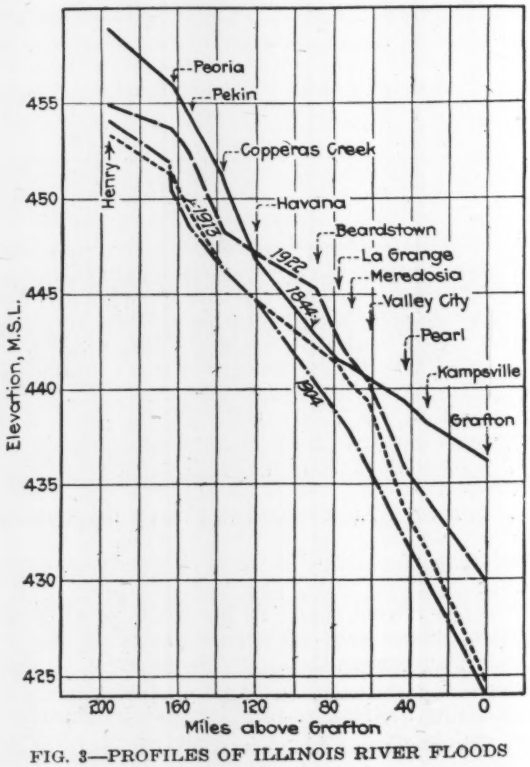


FIG. 3—PROFILES OF ILLINOIS RIVER FLOODS

Havana and 5.0 ft. higher at Beardstown, where the greatest damage resulted.

These increased stages were due largely to the construction of levees for land reclamation, which reduced the natural overflow channel of the river. The failure or overtopping of some levees near the crest of the flood, while allowing waters to overflow and damage surrounding country, did not provide sufficient outlet to cause a material lowering of the stage.

Small Tunnels Lined With Precast Concrete Ribs

Tongue and Groove Sections 9 In. x 6 In. and Weighing 330 Lb. Swung From Flat Cars Into Place by Two Men

AT THE Calaveras Dam of the Spring Valley Water Co. in California, short tunnels were required to admit water from intermediate levels of the reservoir to the intake shaft. As these tunnels traverse swelling ground, it was necessary to provide temporary support. A form of timbering was adopted which would also serve as permanent lining, in the shape of precast concrete ribs, as shown in the accompanying illustration.

Inside the lining the tunnels are 4½ ft. high and have a maximum width of 3½ ft., with a 2-ft. width at the bottom. Three such tunnels are being built at different levels, the total length of the three being 600 feet.

As tried out at first, the ribs were made 6x6 in. in section and weighed about 220 lb. each. These were handled so much more rapidly and easily than anticipated that the size was changed to 9 x 6-in. section, the 6 in. being the thickness of the lining. These larger ribs weigh about 330 lb. apiece; they are taken into the tunnel on small flat cars and after a little practice a crew of two men is able to swing them up into place with ease. As a convenient means of securing good alignment each rib has a V-shaped tongue on one face and a groove of the same cross-section on the opposite face.

Ties under the track laid in the tunnel for construction purposes consist of heavy wood blocks with ends beveled to parallel an inclined surface at the lower ends of the ribs, as shown in the illustration. Two-inch planks are placed along the ends of these blocks and serve to align the bottoms of the ribs and maintain the desired bottom width of the tunnel during construction. As the first rib of each pair is placed, it is held by a wedge near the crown of the arch until the opposite rib is set. After two or three ribs are placed any space behind them is back-filled. As a final operation in lining the tunnel the cracks between adjacent ribs are to be grouted and a 6-in. concrete floor poured.

A 1:2:4 mix is used in the ribs, which are cast in a row at a conveniently located casting yard. Wood side forms were placed for the ribs of the first pour, these forms being so spaced that when the concrete had set and the forms were removed, the space between adjacent ribs was just the width of a rib. In this way the ribs poured first served as forms for a second pour. The only provision necessary to prevent bonding was a thin film of oil swabbed on just before pouring. By taking alternate ribs from the row in this way the wood forms used on the first pour were the only ones required during the entire work.

The work is being done under the direction of George A. Elliott, chief engineer, and T. W. Espy, construction engineer of the Spring Valley Water Co., from whom the foregoing data were obtained.

A TUNNEL LINING MADE OF PRECAST CONCRETE RIBS
Note arrangement of planks and spacers in background designed to hold ribs until invert is poured.

Responsibility for Damage by Piledriving

In a case at law recently decided in London the owners of a building near the site of London Bridge sued the contractors for a new structure nearby, Robert McAlpine & Sons, for damaging their building by subsidence and vibration caused by the driving of piles. The building was over a hundred years old, but it was shown that in November, 1920, when the piledriving began, it had only recently been repaired and was declared to be in good condition. Six months later it had become dangerous and was shored up, and in January, 1922, the owners received notice from the city that the building would have to be torn down. The suit stated that the contractors had driven "671 piles more than 1 ft. square and from 24 to 38 ft. in length," through 16 ft. of made ground into clay, and that more were to be driven. The plaintiffs charged that at a certain depth the clay transmits vibrations like a fluid. The contractors denied the damage and denied that vibration from piledriving was capable of causing injury to property. The judge, however, found that the damage had been caused by the piledriving and that the contractor was responsible. The case is reported in *The Engineer*, Dec. 1.

Dust Removal by Vacuum Sweeping in Grain Elevator

Deposit in Vacuum Machines Fed Into Pipes of Low-Pressure System, Thence to Collector Stations—2 Tons Daily Average

THE first application of the vacuum sweeping system for the removal of dust in grain elevators, in order to reduce or eliminate the explosion hazard, has been made recently in the great Chicago elevator of the Chicago & Northwestern Railway, following the reconstruction of the plant after the dust explosion in March, 1920. The dust removal installation was mentioned in connection with the reconstruction work in *Engineering News-Record*, Sept. 21, 1922, p. 483. This system has been used in other industries but this is the first application on such an extensive scale as is required for grain elevator service. In an average day about 250 bushels or about two tons of dust are delivered to the main collecting station at the Northwestern elevator. This is in addition to a low pressure collecting system.

Since the presence of dust in enormous quantities is unavoidable under present methods of operating grain elevators, the problem is to remove this dust before it accumulates to such an extent as to be dangerous. Removal of the deposits by brooms, scrapers and air jets causes clouds of dust which again settles so that only a part of the accumulation is actually removed from the building. By the new vacuum-sweeping system, which is a development of the familiar vacuum cleaner on a large scale, the dust is not dispersed but is drawn directly through suction nozzles into flexible tubes connected to piping which leads to large collectors or tanks. A vacuum of about 11 in. Hg. is maintained. The deposit in these collectors is fed automatically into the pipes of a low-pressure pneumatic system which delivers it to a main dust collector station at some distance from the elevator. The dust is separated from the air current before it reaches the exhauster, but the collection of the dust was a special problem owing to the great quantities to be handled, so that an ordinary collector would soon be filled. For this reason it was necessary to equip the collectors with discharge locks by which the dust is discharged continually and automatically into the low-pressure piping without the admission of air to lower the high degree of vacuum. The air passing from the collector tank is filled before reaching the exhauster so that it is discharged practically free from dust.

FIG. 1—VACUUM SWEEPING IN A GRAIN ELEVATOR

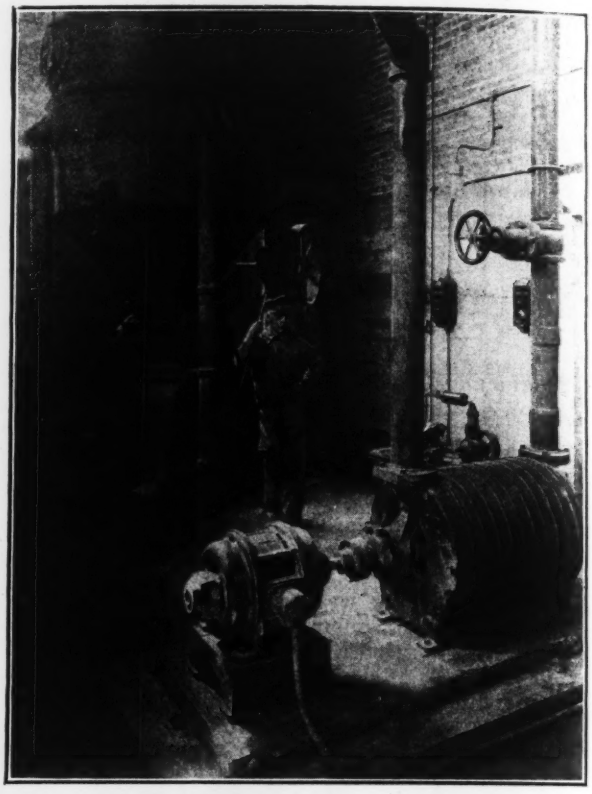


FIG. 2—VACUUM UNIT AND DUST COLLECTOR

Both fine and coarse material are handled, the latter including husks, chaff and grain particles. Fig. 1 shows the cleaning of vertical surfaces, but nozzles of different forms are used in various parts of the plant. For handling piles of material, as where tanks are emptied or grain is spilled, larger hose is employed to ensure more rapid removal. One of the four multistage centrifugal vacuum-producing units is shown in Fig. 2, with its 20-hp. motor and a filter tank which discharges the dust into a pipe of the low-pressure air conveying system. This vacuum sweeping plant for the Northwestern elevator was designed and built by B. F. Sturtevant Co., Boston, Mass.

Smokeless Powder for Blasting

Comminuted smokeless powder, the invention of Maj. John Herbert Hunter, Ordnance Department, U. S. Army, can be used in blasting, being detonated by No. 6 or No. 8 detonators, the rate varying with its fineness. In use the powder should be packed in cartridges, as is the practice with dynamite. Because of the high percentages of poisonous gases produced, it should not be used in mines, tunnels, or other close places unless the ventilation is very good.

Unique Sewage-Works and Pump-Equipment Bid Plan

Sludge from Plain Settling Tanks at Syracuse Mixed With Solvay Lime Liquors — Pump-Equipment Contract Awarded on Basis of Annual Capital and Electric Current Charges

By Glen D. Holmes
Chief Engineer, Intercepting Sewer Board, Syracuse, N. Y.

THE Syracuse Intercepting Sewer Board has recently awarded a contract for the machinery and equipment for its sewage pumping station and grit chamber under specifications containing several features which are of more than usual interest. The specifications provided for alternative bids on variable-speed alternating-current motors of both the slip-ring and brush-shifting types. Each bidder was required to guarantee the calculated annual current consumption charges for the main centrifugal pumps driven by the variable-speed motors, based on the stated hourly fluctuations of flow and pumping heads, and the local power rate schedule.

In canvassing the bids for the equipment, particular weight was given to the efficiencies of the main pumps and the power factors and efficiencies of the motors. In order to determine to whom the contract should be awarded the bids were canvassed by comparing the sums of the annual amortization charges for the equipment and the guaranteed annual main pump current consumption charges submitted by each bidder in his proposal.

General Statistics—Before discussing the pumping station further, it may not be amiss to briefly summarize a few important statistical facts and other pertinent data. According to the 1920 census, Syracuse has a population of 171,717. The greater portion of the city is sewered on the combined system. The intercepting sewers have been designed and constructed for an estimated future population of 400,000 with a per capita contribution rate of 375 gal. per day. The variation in the sewage flow now reaching the treatment site ranges between a minimum dry-weather discharge of 10 m.g.d. to a maximum storm discharge of 150 m.g.d. The average flow for the year 1940 has been estimated at 27.5 m.g.d. and the present works are being constructed to treat twice this average, or 55 m.g.d. Pumping will be required for only such sewage as is to be treated and the excess over the 55-m.g.d. rate will flow around the plant by gravity directly into Onondaga Lake, which also receives the effluent from the treatment works.

Treatment—Sewage on reaching the works will first pass through a venturi flume for measurement and then enter an overflow chamber where excess storm flows will be diverted. From the overflow chamber the sewage to be treated will pass through an inclined rack or bar screen having clear openings of about 3 in., through a grit chamber, then through a mechanically-raked bar screen, with clear openings of ½ in., into the suction well, from which it will be pumped to plain sedimentation tanks equipped for the continuous or frequent removal of the deposited sludge.

The clarified tank effluent will flow by gravity into the outfall conduit and thence be discharged into Onondaga Lake through deep-water multiple outlets located about 1,600 ft. from shore. Sludge from the sedimentation tanks will be removed under water and pumped about 12,000 ft. to the lime waste beds of the Solvay Process Co. At these beds the sewage sludge will be thoroughly mixed with the lime liquors, which carry about forty times as much suspended solids as the sludge and contain about ten times the amount of active reagents required for complete sterilization of the sewage sludge.

COMPARATIVE BIDS FOR TWO TYPES OF MOTORS AND EQUIPMENT FOR SEWAGE PUMPING STATION AT SYRACUSE, N. Y.

Bids were received on Oct. 10, 1922, for slip-ring and brush-shifting motors and corresponding electrical equipment and were compared on the basis of annual amortization charges plus annual charges for electric current, as detailed below.

Item	Public Service Production Co.	John W. Danforth Co.	Roberts Filter Mfg. Co.	McCarthy Brothers & Ford
1a. Switchboard, control mechanism and wiring, brush-shifting type motors	$38,400	$23,247	$22,600	$26,500
1b. Switchboard, control mechanism and wiring slip-ring type motors	39,880	21,237	20,500	24,100
2a. Main centrifugal pumps and brush-shifting type motors	41,175	38,082	40,400	43,000
2b. Main centrifugal pumps and slip-ring type motors	32,025	23,248	24,600	24,600
3 Vacuum priming pumps	2,050	1,836	1,625	2,280
4 Sump pump and motor	2,185	1,794	1,740	3,000
5 7½-ton hand travelling crane	1,740	1,823	1,860	1,850
6 54-in. sluice gate	2,150	1,997	1,890	2,200
7 24-in. gate valves	2,150	1,525	1,750	2,110
8 Main suction and discharge piping	7,785	5,789	5,450	15,900
9 Vacuum piping system	2,425	1,621	1,560	2,350
10 Grit chamber sluice gates	8,200	6,727	8,050	9,300
11 Motor-generator set	1,135	1,012	950	910
12 Tram-rail system	2,100	1,882	2,465	2,240
13 Hoist, cab and bucket	3,685	3,796	3,660	4,360
14 Extra work, cost plus 15 per cent	.....	.....	.....	.....
15a. Guaranteed calculated annual current consumption charges for main pumps, with brush-shifting type motors, per specifications	10,350	9,697	9,760	9,800
Computed annual amortization charges being 7.4 per cent of the sum of Items 1a and 2a to 13, both inclusive	8,523	6,744	6,956	8,584
Sum of computed annual amortization charges for Items 1a and 2a to 13, both inclusive, and Item 15a, brush-shifting type	18,873	16,440	16,716	18,384
Guaranteed calculated annual current consumption charges for main pumps, with slip-ring type motors, per specifications	10,500	10,465	10,300	10,240
Computed annual amortization charges being 7.4 per cent of sum of Items 1b and 2b to 13, both inclusive	7,929	5,497	5,630	7,045
Sum of computed annual amortization charges for Items 1b and 2b to 13, both inclusive, and Item 15b—slip-ring type	18,429	15,962	15,931	17,285

Pumping Station Equipment—The pumping station is a one-story brick building about 46 x 60 ft. in plan. The equipment includes: Four main pumping units, consisting of a 24-in. bottom-suction centrifugal pump direct connected to a 75-hp. a.c. motor; a switchboard and control mechanism whereby the speed of the units will be automatically controlled to maintain the sewage level in the grit chamber at such elevation as is required to keep a constant velocity through the compartments in service; motor-operated vacuum priming units in duplicate, a small vertical centrifugal pumping unit for the drainage of the station and unwatering the several compartments of the grit chamber; a 7½-ton, hand-traveling crane; several hydraulically- and electrically-operated valves and sluice gates; a 10-kw. motor-generator set for supplying direct current for the operation

of the grit-chamber cleaning equipment and various indicating and recording gages and mechanisms.

Each of the four pumping units is designed to handle one-third of the maximum quantity to be treated, one unit being a spare. The ordinary daily peak loads can be carried by two units.

Grit Chamber—The grit chamber has an over-all length of about 70 ft. with three flowing-through compartments each 40 ft. long, 4¾ ft. wide and 8½ ft. deep. The inlet to each compartment is controlled by an electrically-operated sluice gate. The cleaning equipment of the grit chamber includes a clam-shell bucket and cab traveling on an overhead tram-rail extending longitudinally over the center of each compartment.

In the operation of the grit chamber, the principal function of which is to prevent abrasive material from reaching the pumps and causing undue wear, shorter useful life and impaired efficiencies, it is desired to maintain a velocity of about 1 ft. per second. Velocities in excess of this rate do not permit the suspended inorganic matters to settle, while slower velocities are

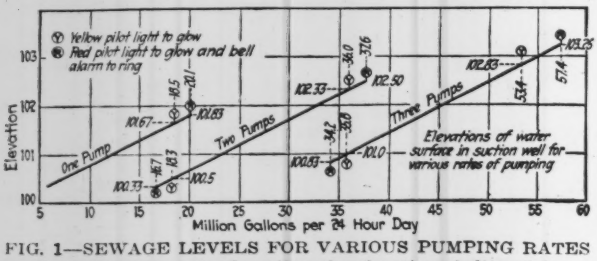

Yellow pilot light to glow
Red pilot light to glow and bell alarm to ring
Elevation
Million Gallons per 24 Hour Day
One Pump
Two Pumps
Three Pumps
Elevations of water surface in suction well for various rates of pumping

FIG. 1—SEWAGE LEVELS FOR VARIOUS PUMPING RATES
When the sewage level reaches the elevations indicated by "Y" a yellow pilot light glows; when levels indicated by "R" are reached a red light glows and an alarm bell rings.

apt to result in accumulation of foul and objectionable organic deposits.

The automatic control and maintenance of uniform constant velocity is without question preferable to manual control by attendants who for various reasons may not give the necessary attention required.

Operating Schedule—The operating schedule is such that for flows of less than 18.33 m.g.d. any one of the three grit chamber compartments may be in service with any one of the four pumping units; any two of the grit chamber compartments with any two pumping units for 18.33 to 36.67 m.g.d.; and all three grit chamber compartments with any three pumping units for flows varying between 36.67 and 55 m.g.d.

The grit-chamber compartments and pumping units are to be manually placed in and out of service, but while in service their operation will be automatically governed by a master controller.

Master Controller—The function of the master controller is to vary the speed of the motors driving the pumps in accordance with the elevation of the sewage level in the grit chamber. The operating conditions are shown in Fig. 1 and the specifications stipulate that the variation in sewage level shall not exceed 1 in. above or below that indicated on the graph when pumping the corresponding volume of sewage. The rate of pumping will be measured by a venturi meter equipped with indicating and recording mechanism.

Within the first stage, when one pump is operating, the master controller is to vary uniformly the rate of delivery of any pumping unit from 5.7 m.g.d. when the sewage level is at El. 100.33 to 20.1 m.g.d. when the sewage level is at El. 101.83.

With an increasing sewage flow, when the sewage level reaches El. 100.67, the controller will cause a yellow pilot light on the master controller panel of the switchboard to glow. This signal will serve to notify the attendant to place a second pumping unit in service, and he will manually start the operation of the second grit-chamber compartment sluice-gate motor, the corresponding screen-raking mechanism motor, the vacuum priming-pump motor and the main sewage-pump motor. Should the attendant fail to note the signal and the sewage level continue to rise and reach El. 101.83, the controller will cause a red pilot light to glow and will continuously ring a bell alarm until the sewage level recedes below El. 101.83.

Within the second and third stages, with two and three pumping units in service, the master controller will function similarly in accordance with the graph, Fig. 1. With an increasing flow, when the sewage level reaches Elev. 103.17, in the third stage, with three grit-chamber compartments and three pumping units in service operating at the maximum rate desired (55 m.g.d.) the three grit-chamber sluice gates will automatically start closing slowly and throttling the inflow until the level below the gate reaches El. 102.83. The gate will then continue to "hunt" so that any increase or decrease in the head above the gate will maintain the sewage level below the gate (in the grit chamber) between the limits of El. 102.83 and 103.17, thus preventing flows in excess of 55 m.g.d. entering the grit chamber. The throttling of the gates and the backing up in sewage level behind the gates will permit the excess flows to discharge over a weir in the overflow chamber and discharge directly to the lake.

Main Pumps—The pumps will be of the horizontal-shaft, single-stage, double-suction centrifugal type, with vertical bottom inlet and horizontal discharge. They are to be designed to give their maximum efficiency at the ordinary total head of 12.6 ft. when pumping at the rate of 13.75 m.g.d., and to give as high efficiency on as flat a curve as possible within the ranges of heads and capacities specified. The estimated annual average hourly quantities to be pumped and the corresponding ranges in head are shown in Fig. 2.

Electric Current—The treatment works are located in close proximity to the municipal garbage-reduction plant which is now operating on alternating current furnished by the Syracuse Lighting Co. Four sources of power (one of which is Niagara Falls) are available for instant interchange, insuring little if any interruption in service. The operating current is stepped down from 11,000 to 440 volts and is 3-phase, 25-cycle. The schedule of rates for power includes a demand charge, an energy charge and an adjustment for power factor, and is such that a substantial reduction in the annual current cost can be secured by the use of one meter for measuring the total current purchased by the city for the two plants. Auxiliary meters will be placed for properly distributing the costs.

Although direct current is perhaps better adapted for the variable-speed motors of the pumping station, estimates of cost indicated that their installation would not prove economical, on account of the necessity for providing large rotary converter units in duplicate and the cost of additional floor space for housing this machinery.

Motors for Main Pumps—The choice of motor drive for the main centrifugal pumps narrowed itself down

to two types; either the brush-shifting or the slip-ring. Although the brush-shifting motors are more economical in regard to current consumption, they require a considerably larger capital investment. From such information as was obtainable from the manufacturers and various users, it appeared that the brush-shifting type of motor might show a lower capitalized cost for installation and operation, but the difference in the estimated capitalized costs was so slight that it was felt that greater competition would be afforded by including both types of motors in the specifications.

In general, each of the motors is to be of not less than 75 hp. rated capacity and capable of developing the specified loads at the necessary speed reductions. The synchronous speeds are not to exceed 500 r.p.m. when operating under no load; the motors are to be designed for continuous service and for direct connection to the centrifugal pumps. Slip-ring motors were to have open-phase wound rotors and a power factor at full load not less than 91 per cent. A power factor of not less than 96 per cent was required for brush-shifting motors at full load.

Canvass of Bids—The legislative act under which the Board operates requires that all contracts be awarded to the lowest responsible bidder. This restriction, if bids were canvassed on the prices submitted for furnishing and installing the equipment, would not permit giving proper consideration to the efficiency of the various units.

All of the funds of the board are obtainable from the sale of 20-year serial bonds, bearing interest of about 4½ per cent, according to market indications at the time of issue. It is, therefore, necessary during the following 20 years for the city to raise by taxation each year for retirement and interest charges an average amount equal to 7.4 per cent of the bonded cost of the work. This 7.4 per cent is designated in the specifications as the amortization charge. It will also be necessary for the city to provide funds in its annual budget for the operation of the pumping station, including electric current, labor, supplies, etc. The cost of electric current is dependent upon the type of motors and pumps and their efficiencies while other annual operating charges will be but little affected.

In order that the slip-ring and brush-shifting motors might both be admitted to the specifications, and be considered fairly and truly upon their performance, and that each bidder might know definitely what consideration would be given for efficiency of performance, the specifications provided:

> The bids will be canvassed to determine the bidder to whom the contracts will be awarded by comparing the sums of the annual amortization charges and annual main-pump consumption charges submitted by each bidder in his proposal, and that responsible bidder whose sum is the lowest will be awarded the contract.
>
> The annual amortization charges shall be computed by multiplying the total amount of the bid for the machinery and equipment by 0.074. This 7.4 per cent average annual charge is computed as the interest upon the serial bonds issued by the city to pay for the work and for the retirement of one-twentieth of the total sum each year until the entire issue is amortized at the end of twenty years.

Tests and Trials—Pressure, endurance, capacity and efficiency tests are to be made prior to acceptance of the equipment. The efficiency tests to determine whether the guaranteed main pump current consumption charges have been met or exceeded are to be made not less than 30 or more than 60 days after the units have been placed in regular service. The tests are to be made under the joint direction of the engineer and contractor. In case of disagreement, an expert of acknowledged reputation, acceptable to both the engineer and contractor, will be chosen and his decision will be final.

The tests and the manner of conducting them are specified in detail. The performance tests of the main pumps are to be made at each hourly rate of pumping and corresponding head shown in Fig. 2. The rate schedules for electric current and method of application, with examples, were presented in full in the specifications in order that there might be no misunderstand regarding the computations and guarantees of the electric current consumption charge.

Bonus and Penalty—A bonus will be paid the contractor if the performance tests show that the guarantee has been exceeded and that the annual current consumption charges will be smaller than the amount stated in his proposal. The amount of this bonus will

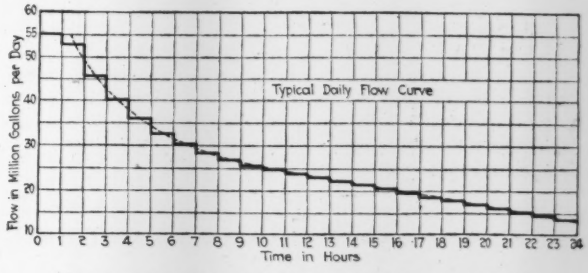

Typical Daily Flow Curve
Flow in Million Gallons per Day
Time in Hours
60
55
50
40
30
20
10
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

FIG. 2—TYPICAL DAILY SEWAGE FLOW CURVE

be one-half the present worth of an annuity, equal to the decrease in current consumption charge, based upon a period of twenty years at 4 per cent compound interest, or $6.795 for each dollar that the test shows the annual current charges to be less than that guaranteed. In case of failure to meet the guarantee a deduction will be made equal in amount to the present worth (as above described) of the excess current charge, or $13.59 for each dollar of excess current cost.

Indicating and Recording Gages—The station will be equipped with somewhat more than the usual number of recording gages to keep the superintendent informed regarding routine operation of the works and the attention given by the attendants of each shift. This equipment includes apparatus for the following records:

Total flow reaching the works—venturi flume.
Total volume pumped and treated—venturi meter.
Discharge head—for each of the four main pumps.
Vacuum in priming system.
Sewage level in pump well.
Sewage level above screens—grit chamber.
One electric time recorder with 12 pens showing time of:
- Starting and stopping each of the four main pumps.
- Opening and closing each of the three grit chamber gates.
- Starting and stopping of each of the three screen cleaning mechanisms.
- Starting and stopping the sump pump motor.
- Starting and stopping the d.c. generator set.

Previous to advertising for bids the unual sections relating to the method of canvassing, tests, trials, guarantees, as well as the bonus and penalty clauses, were thoroughly discussed with manufacturers of pumps, motors and general equipment contractors The general consensus of opinion indicated that the specifications were altogether fair and would result in keen competition. This proved to be the case, as an unusually large number of contractors figured on the work.

During the advertising period some adverse criticism was received from a few pump manufacturers, who objected to the tests for efficiency being made over the entire range of speed variation. They desired the specifications so modified that it would be necessary to make a guarantee of efficiency only against a single stated average quantity to be pumped. One or two manufacturers objected to the tests being made when pumping sewage. As a result of this attitude, which was not announced until shortly before the date set for receiving bids, several prospective bidders did not submit proposals.

The itemized proposals received for the machinery and equipment are given in the table on page 1121. The contract was awarded to the Roberts Filter Manufacturing Co., of Darby, Pa., in accordance with the lowest proposal, which included slip-ring motor equipment.

The equipment to be installed includes: Westinghouse motors, switchboard and control apparatus, Morris Machine Works pumps; Coffin Valve Co., electrically-operated sluice gates; Eddy Valve Co., hydraulic-operating gate valves; Cleveland Crane & Engineering Co., tram-rail system for grit chamber cleaning.

All of the work of the Syracuse Intercepting Sewer Board is being carried out under the direction of the writer as chief engineer, who desires to give special recognition to the valued services of J. X. Cohen, designing engineer.

Use of Copper Sulphate at Hartford and Effect on Filter Runs

Utilized to Lessen Amount of Filtrate—Costs Also Reduced—Runs Long When Micro-Organisms Are Few

By J. E. Garratt
Office Engineer, Water Board, Hartford, Conn.

Abstract of a paper read before the New England Water Works Association.

For several years copper sulphate has been applied to the reservoirs of the Hartford water system at times when the number of micro-organisms has been large. Previous to the filtration of the supply, which began late in the fall of 1921, copper sulphate was used principally to improve the taste and odor of the water. Since the introduction of filtration, the use of copper sulphate has been continued to lessen the amount of material which the filters have to remove from the water and thereby lengthen filter runs and reduce costs of operation.

The new filters were started in a small way in November, 1921. Early in February, 1922, the whole supply to the city was being filtered. Nepaug water was used until the middle of March. During all of this time the micro-organisms were low in number, ranging from 80 to 25. The average amount of water passed between scraping or rakings was about 250 m.g. per acre of filter bed.

From March 17 to April 3, while high-colored bottom water was wasted from the Nepaug Reservoir previous to the spring turn-over, water to the filters was taken from the West Hartford reservoirs. This raw water had a color of about 25. The numbers of micro-organisms was not as low as in the Nepaug water but they were relatively low: 80 on March 17, increasing to 185 by April 3. A filtered water with a color of about 15 was obtained. The rate of clogging during this short period indicated that the quantity of water filtered between cleanings or rakings would have averaged about 250 m.g. per acre had water of this character continued through the filters.

Copper Sulphate Used—Nepaug water was again put onto the filter beginning April 3. By the end of the month micro-organisms had increased to 150 or so, more than one-half being Asterionella. In anticipation of the probable need of treating the Nepaug reservoir with copper sulphate as was done the previous year, the principal West Hartford reservoirs, in which the total micro-organisms had gradually increased to from 240 to 300 (in two Asterionella was the principal micro-organism and in another Nitzschia), were treated with copper sulphate at the rate of 2.3 lb. per m.g., early in the month of May, in order to have them available with water low in micro-organisms for use while the big reservoir was being treated.

Early in May, with Nepaug water, the filters clogged very rapidly. Runs of as little as 40 to 50 m.g. per acre were the rule. It began to look as if night shifts would be needed on the washing outfit. On May 22 Nepaug water was shut off so that the reservoir could be treated with copper sulphate. While the total number of micro-organisms did not seem large yet there were several times as many as in the water which had been used previously. At the surface they totaled 300 and at the depth of 30 ft., 200. It was decided to treat the portion of the Nepaug Reservoir near the intake at the rate of about 1.3 lb. per m.g. The predominating micro-organisms were Uroglena, 50 per cent, and Asterionella, 30 per cent. The treatment, however, was without material results. The total organisms at the surface were not reduced in number while at a depth of 30 ft. they increased very materially to about 600 total.

In the meantime the treated West Hartford reservoir water, with total micro-organisms of 50 to 100, was put onto the filters. filter runs lengthened appreciably to 130 to 150 m.g. per acre between washings, and the washing emergency was passed.

But it was desired to use Nepaug water as soon as possible so it was decided to treat the same portion of this reservoir again. On June 3, 1922, sulphate was applied at the rate of 2.3 lb. per m.g. Total micro-organisms were 250 at the surface and 600 at a depth of 30 ft., half Asterionella and half Uroglena. Quite a few small fish were killed. Samples taken three days after treatment showed a slight reduction in Asterionella and practically no reduction in the number of Uroglena. Samples taken the following day, June 8, showed still further reduction in the micro-organisms at the surface (average total 140) but large increase in number at a depth of 30 ft. (average total 1,030).

On June 9 the change back to the Nepaug water was made, taking water from the intake nearest the surface where the micro-organisms were the lowest in number. On June 14 conditions were the same as on June 8, but by June 21 surface counts had decreased to an average of 65 and at the 30-ft. depth to an average of 100.

Filter Runs Shorten—As a result of more or less off-hand consideration of all this, it appeared that all that was necessary to do in order to keep filter runs long was to keep micro-organisms low in number. Careful watch, therefore, was kept of micro-organisms. No

considerable increase was noticed in the Nepaug water but all of a sudden early in July filter runs of 36 to 50 m.g. per acre were gotten. Experience had shown that filters could be lightly raked over once or even twice without materially increasing the amount of sand to be scraped off and washed ultimately so that no washing crisis seemed at hand, but on several beds there were periods of only ten days between rakings or scrapings and in one case only seven days.

While water in the Nepaug reservoir was low in micro-organisms it was found that water in the West Hartford reservoir into which the pipe line from Nepaug emptied, had developed a considerable growth of micro-organisms (Nitzschia) so on June 8 this reservoir was shut off and the Nepaug water allowed to pass directly to the filters. About July 11 the West Hartford reservoir was treated with 2.3 lb. per m.g. of copper sulphate, the micro-organisms reduced from 270 to about 100 by July 18 and on that day the gate on the line to and from the treated reservoir was opened again. At the time this treated water was again free to pass onto the filters one bed had passed only 60 m.g. per acre and had lost 3 of its 5 ft. of head. Other beds had either just started on new runs or were practically at the end of runs of 40 to 50 m.g. per acre as stated above. A few days later it was noticed that loss of head on the bed which was in the midst of a run began to decrease. It continued to decrease. At the same time a slimy deposit on the walls and bottom of the aerator disappeared. This bed gained a new lease of life and continued in service until Aug. 24 passing 180 m.g. per acre. Runs on other filters since the last of July have varied from 90 to 160 m.g. per acre. Micro-organisms in Nepaug reservoir per acre have continued low, 30 to 50. But at the present time (Aug. 25), micro-organisms in the West Hartford reservoir have again increased to over 300 without as yet causing any noticeable increase in the rate of clogging of the filters.

Presumably we have not as yet got the whole story in regard to the amount of copper sulphate needed for effective treatment or in regard to the relation between number of micro-organisms and lengths of filter runs but it is thought from the information so far collected that the application of copper sulphate has possibilities as an aid to economical filter operation of Hartford water.

Personal Liability Laws for Losses From Fire

A summary prepared by the National Fire Protection Association shows that a number of American communities now have laws which require the owner of premises in which a fire occurs to reimburse the city for the services of the Fire Department, as well as to pay damages to persons or property resulting from the fire, provided the fire is due to non-observance of a fire order or non-compliance with law. Provisions to this effect are found in the charter of New York City, the Pennsylvania State code, and in the city ordinances of Cleveland and Cincinnati, Ohio, Portland, Ore., Billings, Mont., and Austin, Rangers, San Angelo, Cleburne, Wichita Falls, and Greenville, Tex. The summary as published also includes several court decisions bearing on owners' liability in connection with fires, decisions which indicate a drift toward the view incorporated in some European law codes, by which the parties responsible for the origin of a fire are liable for all losses caused by the fire.

Fire-Fighting Ability of Chicago Summarized with Recommendations

A GRADUAL, continuous extension of metered services, an increase in the water pressure to at least 50 lb., and a new high-pressure fire system are the starred [urgent] recommendations of the National Board of Fire Underwriters as to the water supply in a recent report on Chicago. Other recommendations include the following: Combustible material should be removed from pumping stations to render them fireproof; an emergency crew with an automobile carrying gate-operating tools and records should be available; no mains should be tapped before the property needs the service; the distribution system should be strengthened so that it can furnish 1,500 gal. per minute in outlying residential districts, 3,000 to 6,000 gal. in closely-built residential districts of two- and three-story buildings, and 5,000 to 15,000 gal. in inner mercantile manufacturing and lumber districts.

The high-pressure fire system recommended would have a pumping capacity aggregating 30,000 gal. per min., made up of small units in the Chicago Ave., Harrison St. and Fourteenth St. stations. The distribution system should deliver two-thirds of the full capacity about any block with a maximum pressure of 200 lb., and arteries should be so arranged that the failure of any one would not prevent the specified delivery. No dead ends or pipes less than 12 in. are allowable. Gate valves are to be spaced not to cut out more than three hydrants by a single break. Hydrants are to have four gated outlets, to be set on 8-in. gated branches and to be so distributed as to serve an average area not exceeding 40,000 sq.ft. Connections are to be provided for fire boats.

The following paragraphs epitomize the board's findings as to the present water supply fire-fighting facilities and a summary of the whole situation.

Water Supply — Municipal works; organization good; records complete. Supply from Lake Michigan, inexhaustible; cribs and tunnels of sufficient capacity and in good condition. Pumping stations not fireproof, but with low internal hazards and mostly unexposed; mutually reinforce each other; capacity of pumps ample. Distribution in one service, except three small outlying sections. Consumption excessive and its reduction of utmost importance. Pressures too low for adequate fire engine supply in some parts of the city. Arterial system fairly adequate; minor distributors well gridironed. Gate valves generally well spaced and in fair condition. Old hydrants of unsatisfactory patterns, but new hydrants satisfactory; all poorly maintained; distribution mainly good.

Probably the following paragraphs were written with the recent Burlington Building "group" fire in mind:

Building Department—Laws mainly good; several fire prevention features omitted or not sufficiently restrictive. Enforcement somewhat lax. Fire units of large area, but still inadequate. Structural conditions strong to weak in congested value district; new construction in principal portion of district practically all fireproof.

Conflagration Hazard — In the congested value district the increased amount of firepoof construction, especially in the portion south of the river, the increased number of automatic sprinkler equipments (many in buildings which might be classed as conflagration breeders) and the large amount of window protection have reduced the general conflagration hazard. However, group fires are probable in many sections because of poor structural conditions, the frequent high winds and the inability of the fire department to cope with serious fires.

FROM JOB AND OFFICE

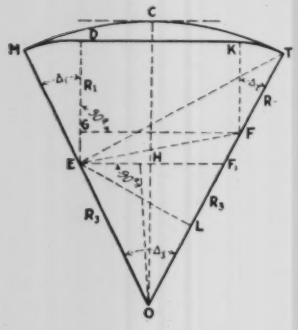
Hints That Cut Costs and Time For the Contractor and the Engineer

Third Curve Replaces Two Curves Joined by Tangent—Four Solutions

In Engineering News-Record, Oct. 26, p. 713, there appeared a solution to a curve problem wherein a third curve replaced two short curves joined by a tangent. The solution offered by Mr. Syme therein has interested engineers widely, and numerous letters have been received in which different solutions to the problem have been set forth. Four of these solutions follow.—EDITOR.

BY BURNETT HAMILTON
Street and Engineering Department, Alameda, Calif.

USING T as the origin of co-ordinates determine the co-ordinates of the points E and F. The direction of the line TFO is known as the point T is fixed. Draw EF_1 locating F_1 so that $FF_1 = ME - TF$. Determine the co-ordinates of the point F_1 and close between F_1 and E, securing the bearing and the length of the line EF_1.



The triangle EF_1O is isosceles and as the directions of the lines F_1O and F_1E are known, the angle OF_1E (which is equal to the angle OEF_1) is known. The angle $EOF_1 = 180$ deg. $- (s\ OF_1E + OEF_1)$, which gives the direction of the line OM.

Solve the triangle EOF for EO,

Then $EO + EM = OM$, the required radius.

* * *

BY J. C. CRAWFORD
Assistant Engineer, Pennsylvania R.R.

GIVEN radius R_2, angle Δ_2, tangent KD, and radius R_1: to find radius R_2 and Δ_1.

$$GE = R_1 - R_2; \quad EF = \sqrt{(GE)^2 + (KD)^2};$$

$$\sin EFG = \frac{GE}{EF};$$

$$EFO = 90° - (\Delta_2 + EFG); \quad FO - EO = GE.$$

Having the base EF, the angle EFO and the difference between the sides EO and OF, the triangle EOF can readily be solved under the rule that "In any plane triangle, as the base is to the sum of the other two sides, so is the difference of those sides to the difference of the segments of the base made by a perpendicular let fall from the vertical angle."

Then $OF + R_2 = R_2$, and $\Delta_2 - \Delta_2 = \Delta_1$.

* * *

BY C. K. CONARD
Northport, Long Island, N. Y.

THE curve TCM is to replace the tangent KD that joins two curves on the ground, and must start at a known point T. From T as an origin of co-ordinates work latitudes and departures through TF, FK, KD and DE, to obtain the co-ordinates of center E. By differences of co-ordinates determine the length and the bearing of ET.

From E draw EL perpendicular to TF produced.

In the right triangle ETL the angle ETL and the side ET are known.

Solve for TL and EL.

Now ME plus EO equals TL plus LO or, EO minus LO equals TL minus R_1 equals a known quantity, say m.

In the triangle EOL, $EO^2 = EL^2 + LO^2$ and $EO - LO =$ the known quantity m, or $EO = m + LO$.

Substituting, $m^2 + 2mLO + LO^2 = EL^2 + LO^2$.

From this, $LO = \dfrac{EL^2 - m^2}{2m}$; $LO + TL = R_2$ and the angle at O may now be found.

Angle MED equals angle O minus angle KFT.

* * *

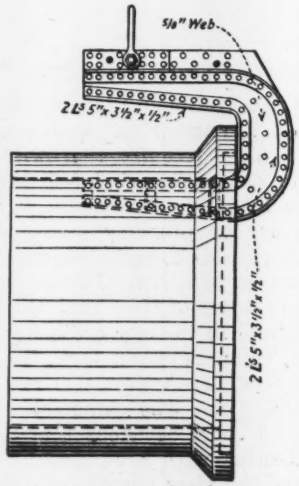
BY E. A. WHITE
County Engineer, Pierce County, Tacoma, Wash.

DRAW the curve MCT and join the centers E and F; draw GF perpendicular to DE, produce TF to a point F_1 making TF_1 equal ME; EF_1 will then connect points on the radial lines of curve MCT and will be parallel to its long chord MT. Bisect EF_1 at H and erect a perpendicular which will intersect TF extended at O, the center of the curve MCT. Solve triangle GFE as before, which gives sufficient data to solve triangle EFF_1.

Then, in right triangle OHF_1 side HF_1 and angle $HF\,O$ can be computed and the triangle solved, giving the data for computing Δ_2 and R_2.

Steel Hook Handles Concrete Pipe

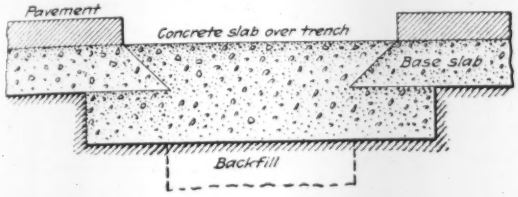
AT THE recent annual convention of the American Railway Bridge & Building Association held in Cincinnati, Ohio, the committee on labor saving devices described in its report a structural steel hook for use in holding the larger sizes of concrete pipe when placed by a derrick. The hook, illustrated herein, is made of heavy structural steel. By adjusting the lifting line to one of the other two holes in the upper part of the hook the pipe can be picked up from one end. The usual manner of setting a pipe is to place a cable or chain sling around the exterior and set the pipe in the desired position. When the sling is removed there is a tendency to uncouple the bell and spigot end. The use of a hook obviates this difficulty and under some conditions expedites the work.



PICKING UP CONCRETE PIPE WITH STEEL HOOK

Trench Backfill Covered with Concrete Slabs

IMPROPER backfilling of trenches has been so great a source of trouble, states H. H. Edwards, City Engineer, Danville, Ill., that municipal control of the



CONCRETE SLAB COVER FOR BACKFILLED TRENCH

replacement of paving over such openings has become necessary. It is now required that for any street opening a permit must be obtained and a bond filed sufficient to protect the city against damage. Backfilling and repaving are done by city forces, the owner being charged the exact cost plus 10 per cent. Over the trench is laid a 12-in. concrete slab extending 12 in. on solid ground on each side, and where a concrete base is cut the edges are sloped to support the trench slab, as shown in the acompanying drawing. For wide or deep trenches, ½-in. transverse bars 6 in. c. to c. are placed 2 in. from the bottom of the slab. With this construction there has been no trouble from sunken pavements.

Precast concrete slabs 5 x 2 ft. and 8-in. thick, reinforced as described above and having the joints grouted, are contemplated as an improvement upon the slab poured in place. It is hoped that this form of concrete base will save time and will permit the replacement of paving in cold weather when it would be difficult to lay new concrete.

Inexpensive Method of Mounting Maps

BY EMILE LOW
U. S. Assistant Engineer, Buffalo, N. Y.

ENGINEERS often find it desirable to mount maps, drawings, documents or photographs. Mounting by use of paste is tedious and having binding done at a bindery is expensive. A better process is to use rubber mounting tissue, which is convenient and cleanly. The other requisites are either a flat, electric or gas iron and a felt pad or ordinary blanket. The procedure is as follows:

Place the pad on a table. The map is then laid face down, after first placing a strip of tissue paper about 5 in. wide around the edge of the map, between the pad and the map and projecting one-half its width outside of the map (this is to prevent the edge of the map from sticking to the pad).

The mounting tissue, of a size to overlap the drawing about ¼ in. all around, is placed on the reverse side of the drawing. The cloth on which the drawing is to be mounted is cut about 1 in. larger than the mounting tissue. It is placed over the rubber mounting tissue and fastened to the board or table at two corners with glass push pins.

Then run an iron over the cloth, beginning at one end and moving along one edge. Then move the iron at right angles to the edge thus fixed.

After the drawing is mounted the edges are trimmed off. In trimming it is advisable to cut about ⅛ in. outside the edge of the drawing as a neater edge can be secured.

Fast Time Recorded in Casting Concrete Segmental Sewer Blocks

WHEN a crew of 12 men first started pouring segmental concrete block sections which form the circular sewer being constructed in Queens, N. Y., and known as the Woodside tunnel sewer, 3 hr. and 40 min. were required to pour the first 72 three-block sections. Each block weighs approximately a ton and 8 blocks

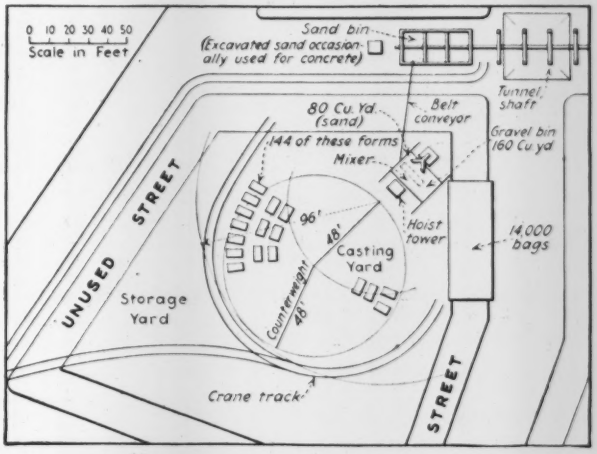


FIG. 1. LAYOUT OF RADIAL CASTING YARD
The radial layout allows all forms to be reached by an easy swing of the boom supporting the chuting. Forms are poured alternately allowing each section 24 hr. in which to set before forms are stripped.

are required to the full circle. When the first day's run had been made the resident engineer told the crew he would not be satisfied until an average pouring time of 1 hr. 30 min. was maintained. Since then the 72 forms have been filled in a record time of 55 min. and in many cases slightly over 1 hr. and the 1½-hr. schedule is never exceeded.

The Woodside tunnel sewer is a segmental block ring with an inside diameter of 11 ft. 9 in. and a uniform

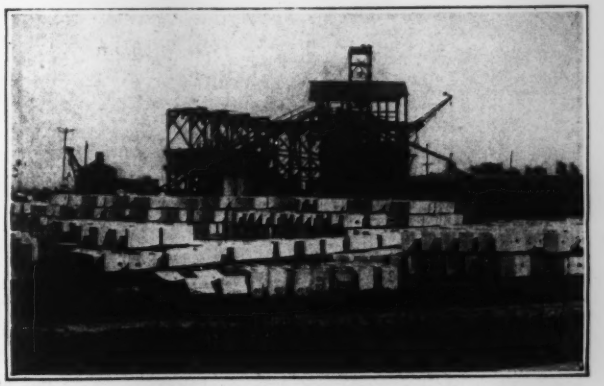


FIG. 2. STORAGE YARD AND CONCRETE PLANT
Dates of casting blocks are easily discernible. Each of these blocks weighs a ton.

wall thickness of 16 in. The contract, which is held by Booth & Flinn, New York City, calls for the construction of 4,025 lin.ft., most of it on Fiske Ave. from Queens Boulevard to Polk Ave.

The yard in which concrete sections are cast has been carefully arranged and located near the shaft so that blocks can be handled practically from the casting

FIG. 3—SEGMENTAL BLOCKS CAST ALTERNATELY
Each form accommodates three 1-ton blocks. By pouring sections alternately 72 sections are poured and 72 sections stripped and the blocks stored every day.

yard to the shaft. The layout of the casting yard is indicated in the accompanying sketch. As is indicated, forms were laid out radially so that an easy swing of the boom (operated by one man) which supports the chuting through which concrete is handled reaches all forms easily.

Specially-constructed steel forms are used and three one-ton blocks are cast within one form. There are 144 forms and pouring is done into alternate forms so that every 72 sections poured are given 24 hr. in which to set before stripping.

A locomotive crane circles the casting yard and a switch is provided at about the center so that blocks can be handled direct from forms into the storage yard from either end of the track. A concrete bed of even grade and smooth surface has been laid as a foundation for section forms, so that little difficulty is experienced in adjusting forms for receiving concrete. After the sections are all poured the recessed forms are bolted on top to give the blocks their lock joints.

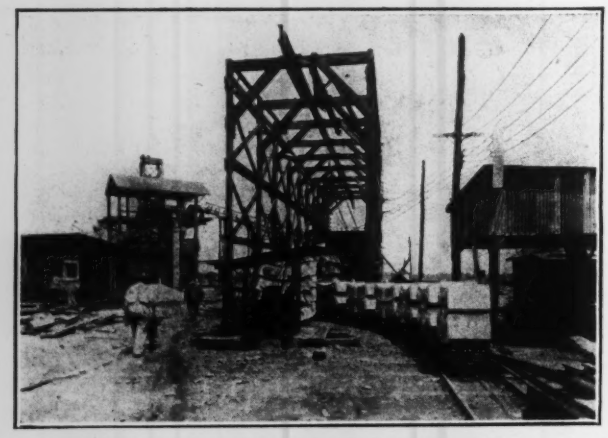


FIG. 4—BLOCKS AT SHAFT ENTRANCE
From the storage yard the blocks are hauled by electric locomotive to the shaft mouth as needed. Enough blocks for a night's run are stored each evening as shown above.

As it is cast each block is marked with the date. When ready to store each block is picked up by the crane fitted with a semi-friction grab onto one side of which is welded a knob that slips into the grout hole of the block. From the storage yard the blocks are loaded onto heavy-truck narrow-gage cars and hauled direct to the mouth of the shaft by an electric locomotive.

The sewer is being built for the Bureau of Sewers, Borough of Queens. A. H. Jorgensen is the contractor's resident engineer.

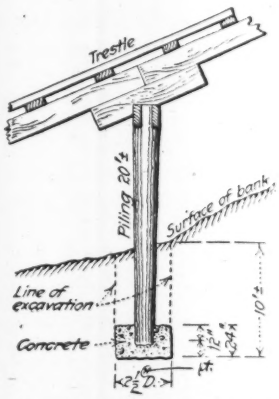
FROM JOB AND OFFICE

Hints That Cut Costs and Time

Piles Are Set in Concrete to Avoid Inconvenient Driving

By George W. McAlpin
Glenwood, W. Va.

DUE TO the necessity of completing work by a certain date and the inability to secure piledriving equipment the writer was led to use the following method of setting instead of driving piling for a sand and gravel incline. The distance from the top of the bank to the edge of the river, over which the incline was to pass, was about 300 ft. To rig up a piledriver to cover this distance would have been expensive. Also such equipment was not available at the time. It was necessary to sink the pile bents, rather than use the ordinary mud sill, due to the tendency of the river to scour at high stages. Consequently, holes for each piling were excavated, the first 4 ft. with long-handled shovels and the rest of the distance, usually 5 to 6 ft., with an extended handle post-hole digger. About 12 in. of concrete was then placed in the bottom of each circular hole, the piling set in and plumbed to correct position and an additional 12 in. of concrete poured around it. The holes were then backfilled and tamped. The method has proved cheap and effective, the concrete forming a perfect base for each piling.



PILES FOR SAND RAMP SET IN BURIED CONCRETE

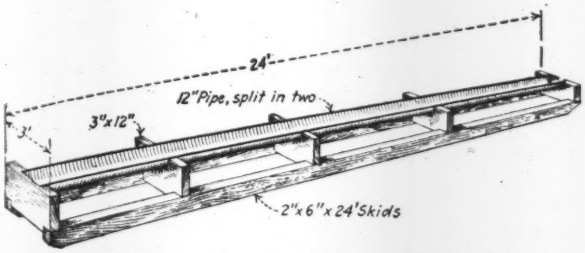
Dipping Trough for Iron Pipe Made From 12-in. Casing

IN THE coastal oil fields rust causes the loss of thousands of dollars annually in new and second-hand materials. The oxidation of iron occurs everywhere to a greater or less degree, but it is especially rapid in this part of the United States, where the climate is subtropical and the humidity extreme. Probably the greatest loss is in the deterioration of drill stem, casing, line pipe, and the like which is not in use.

Painting is the only safeguard, but painting with a brush is a slow and costly process, and, furthermore, the inside of the pipe is not touched. The cheapest and most effective way of applying paint to all surfaces of a length of pipe is by dipping. To facilitate this work,

FROM JOB AND OFFICE

For Contractor and Engineer



CASING MAKES TROUGH FOR DIPPING IRON PIPE

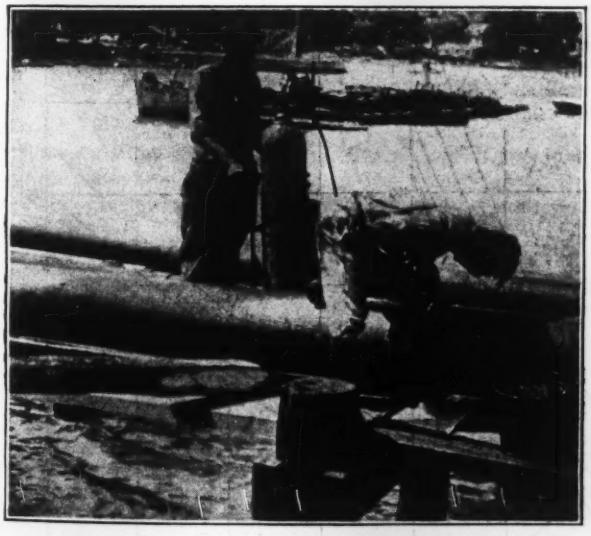
the dipping trough shown in the accompanying illustration was devised. It consists of a semicircular receptacle, about 24 ft. long, made of a short length of 12-in. casing that has been split in two and the two pieces butt-welded by means of the oxy-acetylene blowpipe, and with semicircular plates welded over the ends. The trough is set in a suitable wooden frame on skids.

In using the trough, it is partly filled with the preservative paint. Smaller sizes of pipe are simply immersed; pipes of larger diameter must be revolved once to coat all surfaces. After being dipped the pipe is elevated, two blocks of different heights are slipped under it, and the excess paint is allowed to drain back. —*Engineering and Mining Journal-Press.*

Acetylene Torch Melts Pipe Joint Filler

BY GEORGE C. LOVE
Chief Engineer, Newport News Light and Water Co., Newport News, Va.

THE accompanying photograph shows a piece of work recently completed by this company wherein it was necessary to remove a 14-in. cast-iron water main from a pile trestle. The joints were of the usual bell



BURNING LEAD FILLER FROM PIPE JOINTS

and spigot type with calked lead filler. Water was first drawn from the main and then an ordinary acetylene burning outfit was used to melt the filler. The pipe was left in condition to be used again, part of the lead was recovered and the work was done more rapidly than by any other means available.

Graphs Allow Rapid Yardage Calculation

BY R. C. HARDMAN
Division Engineer, Central Highway Board, Republic of Panama, Aguadulce, Panamá

FOR USE in preparing a preliminary estimate of quantities on a projected location of some 125 km. of highways in the Republic of Panamá, a large part of which was through broken country necessitating much side-hill work, the accompanying graphs were prepared. As will be seen these show the amount of cut or fill per 20-m. station for varying center-line values and varying transverse ground slopes.

The graphs were made by substituting the proper values for the particular cross-section of roadway to be used in general equations derived in terms of center-

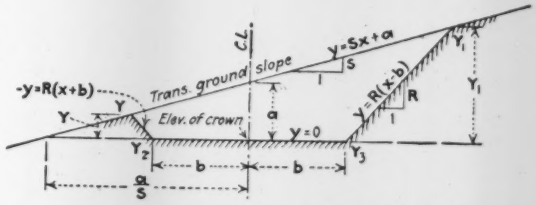


FIG. 1—SECTION USED IN FORMULA DERIVATION

line values, width of base, side slopes and transverse ground slopes. As will be seen, two general equations are necessary—one when the section is trapeziform and the other when the section is triangular.

Referring to Fig. 1:

Let a = depth of cut or height of fill on center line
b = one half width of base
R = ratio of side slopes
S = ratio of transverse ground slope
A = area of trapeziform section
A_1 = area of triangular section.

The equations of the four lines forming the trapezium are:

$$y = Sx + a$$
$$y = R(x - b)$$
$$-y = R(x + b)$$
$$y = 0$$

Solving for the co-ordinates at the common points Y, Y_1, Y_2 and Y_3 we have:

$$Y = \frac{R(a - Sb)}{R + S}$$
$$Y_1 = \frac{R(a + Sb)}{R - S}$$
$$Y_2 = Y_3 = 0$$

Then
$$A = \frac{\left(\frac{a}{S} + b\right) Y_1 - \left(\frac{a}{S} - b\right) Y}{2} \qquad (1)$$

Substituting the above values for Y and Y_1 Equation (1) becomes

$$A = \frac{a^2 + 2Rab + (Sb)^2}{R - \frac{S^2}{R}} \qquad (2)$$

Which is the general equation for the trapeziform section.

When the line $y = Sx + a$ passes through the point Y_1, $\frac{a}{S} = b$ and Equation (1) becomes the equation for the triangular section by the dropping of the last term of the numerator, which is equal to zero.

Therefore
$$A_1 = \frac{\left(\frac{a}{S} + b\right) Y_1}{2} \quad (3)$$

which becomes
$$A_1 = \frac{a^2 + 2Sab + (Sb)^2}{2\left(S - \frac{S^2}{R}\right)} \quad (4)$$

when the values for Y_1 are substituted.

For use for any particular cross-section, the values of b and R are substituted for the general case and value of S for the special cases and the equation becomes of the form $A = Aa^2 + Ba + C$ from which curves can be rapidly made.

If ditches, surfacing trenches, etc., are to be used their area must be added or subtracted as a constant for all values of a when $a > Sb$ and the proper proportion of such area when $a < Sb$.

For purposes of actual use the center-line values are taken from the profile and tabulated, the rate of ground slope is taken from the topography and tabulated beside the former so that both variables will be together for picking quantities off the chart, the plotted curves being, of course, ($A \pm$ Ditch constant) times length of station.

In taking off the rate of ground slope, the easiest method is by counting the number of contours crossed by a known unit of measure, such as one centimeter, depending upon the scale of the map.

It will be noted that the curves take care of the combined cut and fill section which occurs when $a < Sb$, by showing two readings for any given transverse slope.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Contractor and Footing Course

By Frank E. Sanborn
Oxford, Ohio

DOES every construction superintendent and foreman realize the harm he may do by lack of care in building the footing courses? The designer has planned his footings for equal settlement of the whole foundation, adjusting the loadings to the different kinds of soil encountered, and he wants the pressure to be uniform across the footing course. All this planning is made useless by wrong location or size of the footing course.

Errors in footing location may come about through wrong measurement on the ground, carelessness in staking out the trench, or digging away from the line. Any of these causes will produce a loading on the ground which is not uniform as intended but is greater at one edge than at the other, a condition which invites unequal settlement. The man laying out the trench or hole may regard it as rough work, sufficiently close if there is a footing course under the wall no matter if it is wider than called for, especially as the work is soon covered and out of sight; yet due care is as important here as at any other place in the structure.

Uniform distribution of load is secured only when the load comes in the center of the footing course. Any foreman or laborer can verify this fact by placing a block of wood on the surface of soft ground and stepping on it: if his foot rests on the center, the block squeezes down evenly, while off-center loading makes the nearer edge sink down deepest and causes the block to tip.

What is the amount of these inequalities of pressure resulting from off-center loading? For the simplest case we may compare a correctly located footing, Fig. 1.

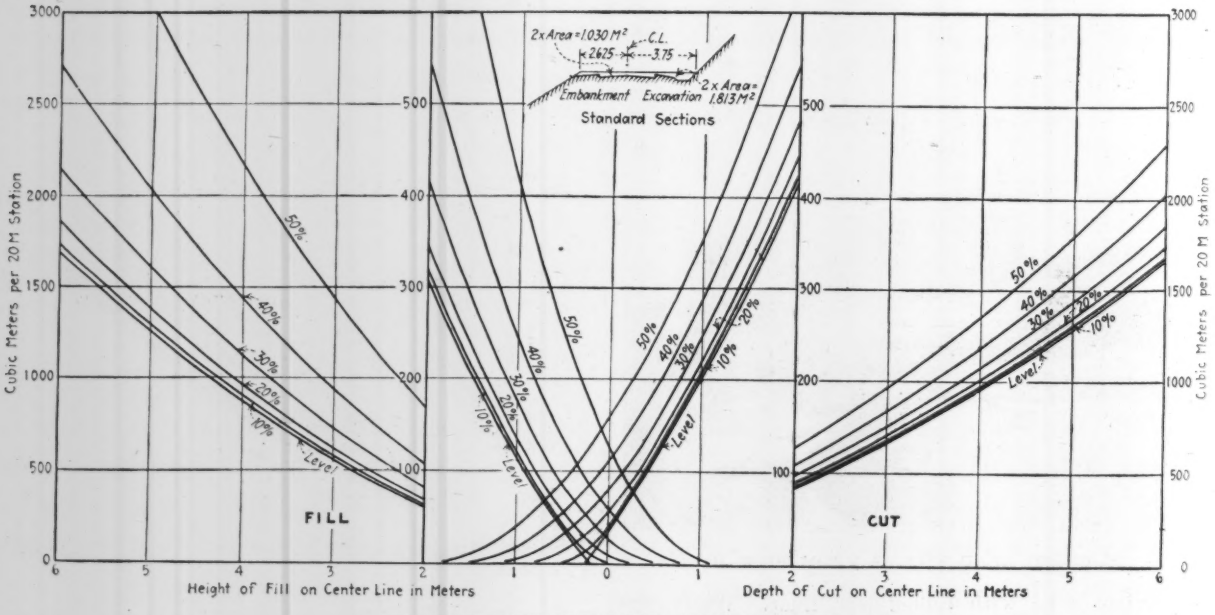


FIG. 2—GRAPHS FOR ESTIMATING YARDAGE

As is apparent, the flatter curves are but continuations of the sharp ones, though on a larger scale.

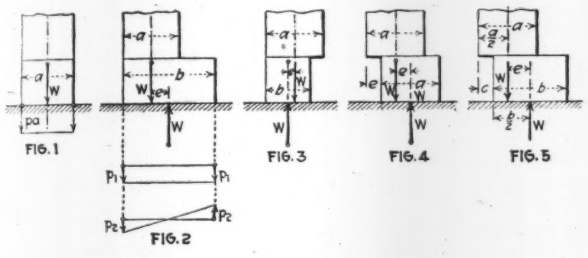
FROM JOB AND OFFICE

For Contractor and Engineer

with a footing widened out on one side, Fig. 2. In Fig. 1 the load W comes in the center of the width of the footing course and the pressure per square inch of area is the same everywhere,

$$p = \frac{\text{Weight on the footing per inch of length}}{\text{Inches of width}} = W_a$$

In Fig. 2 we have the same load W, at the same distance from the unaltered side of the footing, but the soil loading is non-uniform. The greatest load per square inch, p_{max}, will be $p_1 - p_2$ or,



FIGS. 1-5—BADLY BUILT FOOTINGS

$$p_{max} = \frac{W}{b}\left(4 - 3\frac{a}{b}\right)$$

which means that the intended loading p has been multiplied by the factor

$$\frac{p_{max}}{p} = \frac{a}{b}\left(4 - 3\frac{a}{b}\right).$$

At the opposite edge of the footing the intended loading has been reduced in the ratio

$$\frac{p_{max}}{p} = \frac{a}{b}\left(3\frac{a}{b} - 2\right).$$

$\frac{a}{b}$	$\frac{p_{max}}{p}$	$\frac{p_{min}}{p}$	$\frac{a}{b}$	$\frac{p_{max}}{p}$	$\frac{p_{min}}{p}$
1.0	1.0	1.0	0.5	1.25	—0.25
0.9	1.17	0.63	0.4	1.12	—0.32
0.8	1.28	0.32	0.3	0.93	—0.33
0.7	1.33	0.07	0.2	0.68	—0.28
0.6	1.32	—0.12			

These values are plotted in Fig. 6. The negative values mean that the top part of the projection of the footing course would press upward against the soil upon it.

Thus it appears that if a foundation course is widened on one side, the maximum pressure per square unit of area upon the soil is increased, unless the footing is made more than three times its proper width. If a 16-in. course is made wider on one side by 4 in., making its total width 20 in., then $\frac{a}{b} = 0.8$ and $p_{max} = 1.28\ p$; that is, the greatest pressure is 1.28 times the designed pressure. If the designed pressure is 4,000 lb. per sq.ft., then the greatest pressure becomes 5,120 lb. per sq.ft., while the pressure at the opposite edge is only 1,280 lb. per sq.ft., so that the greatest pressure is four times the smallest pressure. With this unequal loading of the soil, tipping of the footing course due to uneven settlement is to be expected.

The footing course may be reduced in width on one side, Fig. 3. Then the same formulas apply, merely interchanged; the pressure ratios are plotted in the right-hand part of Fig. 6. A 16-in. course reduced by 1½ in. on one side would have a 14½-in. width and a value of $\frac{a}{b} = 1.1$; the greatest pressure would become 1.43 times the designed pressure. For an intended soil loading of 4,000 lb. per sq.ft., the actual loading at one edge is 5,720 lb. per sq.ft. and that at the opposite edge 3,080 lb. per sq.ft.

If the course is widened or narrowed equally on both sides, then the load would be uniformly distributed upon the soil, but of less or greater amount respectively than planned and so not in keeping with other footings.

If the footing is of proper width but wrongly located, an eccentric load results as shown in Fig. 4 and plotted in Fig. 7, the factor of pressure increase being

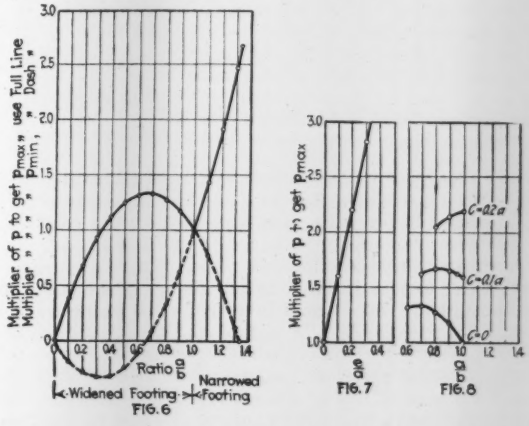
$$\frac{p_{max}}{p} = 1 + 6\frac{e}{a}$$

It is possible also that a footing may be both widened and misplaced, or widened on one side and narrowed a less amount on the other side, as in Fig. 8. For this condition the factor is

$$\frac{p_{max}}{p} = \frac{a}{b}\left(4 + 6\frac{c}{b} - 3\frac{a}{b}\right)$$

and may be represented by a series of curves depending upon the relative values of the widening and the narrowing. Three of these curves are given in Fig. 8.

Thus, good building practice requires that the contractor follow the plans closely in laying out and constructing a foundation. Lines should be stretched and stakes driven in the proper places; digging should follow the line, the sides of the trench be pared plumb, and the bottom be made level. Plumb-bobs hung from lines stretched between batter-boards will be helpful. A carpenter's or mason's level will be found of service. Any widening in an earth form for concrete should be corrected with form boards and not filled out with the concrete in the thought that the extra concrete is cheaper than the form boards. Some foremen think that a widened base always reduces the loading on the soil, but they are wrong.



FIGS. 6-8—PRESSURE RATIO IN UNSYMMETRICAL FOOTINGS

Fig. 6—One side of footing misplaced. Fig. 7—Footing shifted sideways. Fig. 8—Width and location wrong.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Studies of Flow of the Tennessee River

Sir—Permit me to call attention to a statement in the article by Benjamin E. Jones on "Flow in Tennessee Checked Against Hydraulic Formulas," appearing in *Engineering News-Record*, Oct. 12, p. 610, as follows: "The extent to which the values of n and C obtained in these experiments could be applied to other similar channels depends, of course, on the relation that the cross-section at the bridge on the Tennessee River bears to the average cross-section of the whole stretch of channel involved in the measurements —on the whole the area at the bridge doubtless represents fairly well the cross-section of the seven miles of channel."

Experiments upon channels show that even where the locations are selected for investigation because of their regularity, considerable variations in cross-section and hydraulic radius are present. The case of a measurement on the Ohio River at Cincinnati might be cited where the maximum variation of the area was "from about 15 per cent below the average to about 14 per cent above," and the maximum variation in the hydraulic radius was "from about 23 per cent below the average to about 33 per cent above." (Quotation from "Calculation of Flow in Ohio Channels," by Ivan E. Houk; Miami Conservancy District Technical Reports, Part IV., p. 119).

A section selected at random in a crooked river is therefore not likely to represent "fairly well" the average cross section. In fact, while such a section may be nearly the average, it is more likely to be considerably different, especially at low stages. Any conclusions based upon such an assumed condition are liable to be entirely untrustworthy. It is greatly to be regretted that a number of other cross-sections were not available for use in determining the real average cross-sectional area of the river, as the data would then be very valuable and interesting, but without them any conclusions drawn from the data must be regarded as "not proved."

E. W. LANE.
Representative of the Morgan Engineering Companies.
Yangchow, Ku., China, Nov. 7.

[Mr. Jones submits the following reply.—EDITOR.]

Sir—The results of slope and discharge measurements on the Tennessee River were published to show the relation, if any, between variations in values of C and variations in values of hydraulic radius and slope. The measurements answer this purpose whether or not the cross-section is uniform throughout the channel involved. For example, measurement 33, with hydraulic radius of 10.9 ft. and slope of 0.0000506, shows a value of 40 for C, whereas measurement 34, with hydraulic radius of 10.5 and slope of 0.0000839, shows a value of 52 for C. A change in the average cross-section would have little effect on the relative values for C.

Mr. Lane's criticism would apply only if it is desired to use the values of C and n found for the Tennessee River in computing the discharge of other channels. In that case they would necessarily be used in connection with other similar measurements and the engineer would give them such weight as the facts in his opinion warranted.

A survey of Tennessee River made in 1910 shows an average width at low water in the stretch of channel covered by the slope measurements about 15 per cent greater than at the bridge at Chattanooga. The average depth of water at different cross-sections was nearly uniform. The survey was made before the Hale's Bar dam was constructed and there may have been changes since in the average depth but probably not in the average width.

BENJAMIN E. JONES,
Hydraulic Engineer, U. S. Geological Survey.
Washington, D. C., Dec. 19.

A Protest Against "Sales Engineer"

Sir—Is it not time to do away with the term "sales engineer" before it gets any further? The writer's objection is that there is no such thing. Selling is not in any sense engineering; and while an engineer may leave his occupation and take up selling, yet such an act does not make him a sales engineer. It is true that a technical training often qualifies a salesman to do better work in the promotion and selling of engineering supplies; but he is then an engineering salesman, not a sales engineer.

The ethics of the two occupations are incompatible. If a salesman applied a professional man's ethics to his own work, he would soon be out of a job. Should an engineer use a salesman's methods he would be accused of sharp practise. A salesman has little identity of interest with his customer; he "sells" his customer in the interest of the manufacturer by whom he is paid. An engineer would act unprofessionally if he recommended the purchase of any material or process the use of which would result in his gain. He gives service to, and is paid by, the customer whose interests and his are one.

It is to be regretted that a name, as soon as it gets a reputation that is at all advantageous, is borrowed or stolen by others for its reflected credit. It is to be expected that many manufacturers will want to call their salesmen engineers; but the last thing to happen should be for engineers to use the name themselves that way. The writer invites the attention of both the American Association of Engineers and also the American Society of Civil Engineers to this matter, for the words "sales engineer" are used freely in the employment bulletins of both societies. Among the mechanic arts we are all familiar with the hoisting engineer, the stationary engineer, etc.; with the encouragement now given by engineers to the general use of their name, we may soon look for its adoption in a variety of indoor lines, such as sales engineer for drummers and floor-walkers, accounting engineer for clerks and bookkeepers, and tonsorial engineer for barbers.

Faribault, Minn., Dec. 16. A. W. BEDELL.

Liquid Pressure and Coal Bin Design

Sir—The letter of Edward Godfrey in *Engineering News-Record* of Nov. 9, p. 808, seems to require elaboration of some statements in my letter in the issue of Oct. 19, p. 669.

My objections to a method of approximating the lateral pressure of granular materials, such as sand, grain, coal earth, etc., are based upon theoretical, experimental and economic grounds. That granular materials, for example coal in a bin, do not act like liquids is evident and will probably be accepted by all. That no liquid-pressure formula can take into consideration the effect of surcharge or of the width of the bin is also true. Of course, tables of coefficients may be computed to take care of each individual case, but, if they are reliable, such coefficients have been computed by taking into consideration the physical properties (those possible values which will give the maximum pressure) of the material in question. The Pascal law for liquid pressure requires that the lateral pressure be independent of the width of the containing vessel. But the pressure of a granular material on the side wall of a narrow bin is not as great as that on a wider bin, all other conditions being the same.

Some of the supporters of the "equivalent liquid pressure" method recommend the formula P, a horizontal pressure, equals $\frac{1}{2}Cwh^2$; the value of C is then given as $tan^2 \frac{1}{2}(90°-\phi)$, where ϕ is the natural slope. Substituting, we see that the formula is really Coulomb's formula for the pressure of a horizontal fill against a perfectly smooth wall with a vertical back face, after Woltmann's assumption that the tangent of the angle of natural slope was equal to the coefficient of internal friction had been added. Incidentally, I might mention that Coulomb did not include the natural slope in his theory, based on the wedge of maximum pressure. I realize that most texts do not emphasize Coulomb's own restrictions to his formula, but they can be found in the original papers, "Memoires de l'Academie Royale des Sciences"

T. 7, 1773, or in "Theorie des Machines Simples" by Coulomb. A second edition (1821) of the latter is in the Congressional Library. Later developments of this theory assume the existence of a vertical component in all cases (since the wall cannot be perfectly smooth) and also take care of all cases of surcharge or sloped wall.

Unfortunately, experimental data on a scale large enough to be applicable are rather meager. However, the tests mentioned below, where work with sand, grain and earth is reported, all seem to show the reliability of the wedge theory, at least as a close approximation. Tests with similar materials in different parts of the world with unlike types of apparatus check each other so closely that there can no longer be any argument about the existence of a component along the wall. Lack of space prevents more than the references:

A. A. Steel: *Engineering News*, 1899, p. 261;

H. Mueller-Breslau: "Erddruck auf Stuetzmauern," 1906;

R. B. Fehr and C. R. Thomas: Penn. State College Bulletins 8 and 11, 1912-13;

P. M. Crosthwaite: Proc. Inst. C.E., 1916, 1920;

A. R. Fulton: Proc. Inst. C.E., 1916;

M. Enger: *Proceedings*, A.S.C.E., 1920, p. 251;

F. H. Hummel and E. J. Finnan: Proc. Inst. C.E., 1921, p. 369;

Preliminary Cincinnati Tests: *Engineering News-Record*, Aug. 25, 1921, p. 314; Jan. 19, 1922, p. 106.

It is hoped that the complete set of tests on sand performed by the writer at the University of Cincinnati, 1921-2, may soon appear in print.

Practically, the use of an approximate method based on assumed coefficients is neither economical nor safe. It is true that no exact design of a retaining wall or bin is at present possible. That is so because of lack of information, but is no reason for not using what information is available. Incidentally, where in engineering design can we point to an exact method? But, in order that the approximation be closer and therefore more economical, and based upon experimental data and therefore safer, it is advisable to beware of easy, short-cut formulas, especially since those who do not realize that there are limitations to such formulas are the ones likely to place greatest faith in them. R. W. Dull in *Engineering News*, Aug. 21, 1904, gives a complete set of formulas and coefficients for the design of steel bins, based upon both the Poncelet wedge and the Rankine theories. They are no harder to use than the "equivalent fluid method" and have the advantage of experimental verification, to some extent anyway. Until we know more about granular materials and their action, it seems to me that extra care should be taken in designing structures where the action of such materials must be taken into consideration.

JACOB FELD,
Formerly, Baldwin Fellow in Civil Engineering,
Brooklyn, Dec. 4. University of Cincinnati.

Sir—If Mr. Feld would boil down his objection to the equivalent-fluid-pressure method of designing retaining walls and bins, there would be only two points left. One of these is that the equivalent fluid pressure method does not include nor imply the existence and effect of vertical friction on the side of the wall or bin. The other has to do with the effect of surcharge.

Taking up first the case where there is no surcharge: The horizontal pressure on the side of a wall or bin, as found by the equivalent-fluid-pressure method, is absolutely identical with the tabular results found by R. W. Dull in *Engineering News*, July 21, 1904. This is true both of the case where vertical friction is neglected and the case where a certain angle of friction is assumed, though, of course, the coefficient or unit weight of "liquid" is different in the two cases. Furthermore, by using a proper unit weight of fluid the lateral pressure for the case of indefinite surcharge is identical with that worked out by Mr. Dull, to which Mr. Feld refers as a correct method.

The effect of vertical friction on a coal bin is not used at all in the design. In a retaining wall it is an aid to stability which is too uncertain to enter as an element in design and had best be neglected.

As to the work saved: It is certainly easier, say in the case of horizontal beams in the side of a bin, simply to take the depth from the top of bin as a basis for fluid pressure and to design each beam for its spacing and span, rather than to find the total wedge pressure for the whole side of the bin down to that beam and half way to the next and deduct the wedge pressure to the mid-space to the beam above, as Mr. Feld's theory and method requires. Besides this, a designer feels far more secure with a simple method of unit loads, easily checked, than with a long formula.

The surcharge in a coal bin, which may be a wagonload of coal, or even a carload, piled in a pyramid on top, does not justify entering into extremely complex theory in design. Probably not one engineer in five hundred could apply the theory to this problem without giving it study for a day or two. I am among the 499, for I give very little time to theories that have so little of the practical to commend them. I venture to say that, given identical bins to proportion, on identical unit stresses, Mr. Feld's theoretical method and my rough one, given in *Engineering News-Record*, Nov. 9, 1922, would produce identical beam sizes. This, it seems to me, is the proof of the pudding.

Pittsburgh, Dec. 8. EDWARD GODFREY.

The Ventilation Problem in the Light of Recent Research

Sir—I have read with much interest the letters in *Engineering News-Record* of Dec. 7, 1922, on "Sanitation, Ventilation and Vaccination" by F. W. Harris and Rudolph Hering's comments on p. 1040 of the following issue, entitled "Ventilation, Body Temperature and Health." It would be most short-sighted to minimize our debt to vaccine and serum therapy. Vaccination has played a large part, along with sanitation, in the conquest of typhoid fever; and vaccine and serum therapy promises far more than any other measure in the control of pneumonia which we hope for but have not yet attained. Yet it is well that the importance of air conditioning as a factor in building up vital resistance should be emphasized. As you pointed out in your one line of editorial comment on Mr. Harris' letter, these procedures are fortunately not mutually exclusive. Let us by all means "vaccinate, ventilate and sanitate."

Mr. Hering's emphasis on the importance of air conditioning is more than justified for there is no more neglected field of applied physiology than the hygiene of the skin. The work of the New York State Commission on Ventilation (to be presented in book form by E. P. Dutton & Co., during the coming winter) makes it clear that overheating of occupied rooms is a factor of the first importance in reducing efficiency and increasing respiratory disease.

It is important, however, to note that modern ideas of ventilation with their emphasis on temperature control, rather than the removal of hypothetical and non-existent atmospheric poisons, demand a somewhat radical change in ventilation practice. The studies of the New York State Commission on Ventilation indicate that the ample air flushing (30 min.-ft. per person) required by the laws of many states is not only unnecessary but positively harmful since such an excessive air flow inevitably tends to overheating, discomfort, and increased respiratory disease.

Mr. Harris' statement that "windows are for light and should only be used for this purpose during the winter months" will not be accepted by those who have followed recent advances in this field, for the best general system of schoolroom ventilation which we observed in the studies of the New York State Commission is that which admits air over slanting window boards, with ample radiation below to moderate its temperature, and with gravity exhaust ducts for the removal of vitiated air from near the ceiling. The substitution of this system for fan ventilation will not only save money in construction but will also effect material saving in operation (since a much less volume of air must be warmed per hour) and will promote both the comfort and the health of the occupants.

New Haven, Conn., Dec. 16. C.-E. A. WINSLOW,
Professor of Public Health,
Yale School of Medicine.

NEWS OF THE WEEK

New York, December 28, 1922

Reclassification of Federal Employees Doubtful

Heavy Work Devolving Upon the Senate Appropriations Committee May Keep Measure Out

Washington Correspondence

Although several hearings have been held by a sub-committee of the Senate appropriations committee, the final report on the bill to reclassify the employees of the federal government and readjust salaries has not been formed and in view of the heavy work devolving upon the appropriations committee because of the annual supply bills fears are expressed that the reclassification measure will not be brought to action on the floor in time to assure passage at the present session of congress. Senator Smoot, chairman of the sub-committee in charge of the bill, has stated, however, that a report may be expected shortly.

Friends of the reclassification bill are dubious of its passage in the present Congress even with a report coming in January because of the doubt over the shape in which the bill will appear when it does come from committee.

FURTHER CHANGES PROPOSED

The civil service committee of the Senate considered this measure some weeks and reported it with a recommendation that it be passed on Feb. 8, last. Because of the financial features of the bill, it was referred to the appropriations committee for further study. The civil service committee made a number of changes in the bill from the form in which it was passed by the House. While the sessions of the sub-committee on appropriations have been executive, with a number of government officials testifying as to their ideas, it is generally understood that further changes have been seriously considered by this committee. Senator Smoot himself is the author of another reclassification bill which originally projected reforms based upon a somewhat different theory than those contained in the Lehlbach-Sterling bill, which was the basis of the one now under consideration.

It is said that the appropriations committee has been considering further reductions in the number of classes outlined in the bill, and that there has been serious thought of eliminating workers in the field and confining the measure to government employees within the District of Columbia. Changes in title and in relative pay for professional and sub-professional workers also have been suggested, it is said, because these men are leaving the service in increasing numbers.

Franklin Furnace Typhoid Outbreak Reaches 16 Deaths

Up to Dec. 15 the typhoid outbreak at Franklin Furnace, N. J., noted in *Engineering News-Record*, Dec. 14, p. 1045, had resulted in about one hundred reported cases and sixteen deaths.

New Jersey Road Bonds in Demand at Good Premium

Bids for $2,000,000 of 4¼ per cent highway bonds of the State of New Jersey brought offers totaling about $50,000,000 on Dec. 19. The highest of nine bids for the entire issue was at the rate of 102.097 and secured the award. Bids for portions of the issue ranged from par to 103+ but the syndicate bid gave a higher yield than the best of the fractional bids.

Special Train for A.G.C. Convention

A special train will take the members of the Associated General Contractors to the annual convention at Los Angeles, Calif. Assembling at Chicago at the close of the Good Roads Show the members will leave by the Atchison, Topeka & Santa Fe Ry., at 6 p.m. Jan. 21 and arrive in Los Angeles at 12 m. Jan. 29. The trip will include a stop at Grand Canyon. For the return trip a choice of three routes, via the Union Pacific, the Southern Pacific or the Chicago, Milwaukee & St. Paul railways will be afforded. Complete schedules of the several trips, including excursions and stops at points of scenic interest, and giving railway fares, may be secured from the Associated General Contractors, Munsey Building, Washington, D. C.

Shreveport Division of Katy Sold at Public Auction

The Shreveport division of the Missouri, Kansas and Texas R.R., from Greenville, Texas, to the Louisiana state line; and the McKinney branch, between Greenville and McKinney, Texas, were sold at public auction in Greenville Dec. 16 for $700,000, the minimum price asked by the court. The lines involved in the sale total approximately 180 miles.

The sale of the branch lines at Greenville ends the receivership of the "Katy" R.R. that has been in effect since September, 1915, and also brings to a close the successful reorganization of the Katy lines, which has been worked out by a group of New York bankers headed by firm of J. W. Seligmann & Co.

It is planned to extend the line west for a connection with the Ft. Worth & Denver City, but just what point at which the connection is contemplated is not generally known. The road will have direct connections with Dallas and Ft. Worth and other important shipping centers.

The deal above mentioned will eventually give the Edenborn lines 523 miles of railroad through a rich lumber and farming belt, also two deep waterways.

Concrete Institute Program Is Announced

An exceptionally live and interesting program has been provided for the nineteenth annual convention of the American Concrete Institute to be held at the Hotel Sinton, Cincinnati, Ohio, Jan. 22-25, 1923. The meeting starts at 2 o'clock Monday afternoon with a special session on concrete products manufacture and has a meeting that night; Tuesday, Wednesday, and Thursday there will be three meetings each day, the Wednesday evening session, however, being devoted to a get-together social meeting.

Papers include methods of making concrete pressure pipe, by W. G. Chace of the Lock-Joint Pipe Co.; design and construction features of the ideal section of the Lincoln Highway, by W. G. Thompson; trend of design and construction of concrete roads, by H. Eltinge Breed; correction data for comparative test results from field specimens, by G. W. Hutchinson; effect of impure water on the strength of concrete, by Prof. Duff A. Abrams; design of elastic structures from paper models, by Prof. George E. Beggs; an interesting case of dangerous aggregate, by J. C. Pearson; thoughts on concrete houses, by J. C. Pearson; developments in surface treated concrete, by R. F. Havlik; some defects in concrete buildings, by H. C. Loring; inundation methods for measurement of sand in making concrete, by W. A. Slater and G. A. Smith, of the U. S. Bureau of Standards; analysis of the variables in concrete from the construction standpoint with some results of job tests, by W. P. Bloecher, Stone & Webster; and causes of steel corrosion and concrete disintegration, and methods of their prevention, by M. M. Upson.

In addition to this there are the usual presentation of specifications, a number of which this year are of great importance and a whole session devoted to a question box to which already some very important questions have been submitted. The secretary of the Institute is Harvey Whipple, 1807 East Grand Boulevard, Detroit, Mich.

Reclamation Levee Under Way on North Sulphur River

The Howard-Kenyon Dredging Co., of Houston, Texas, has unloaded a dredging machine at Cooper, Texas, to be used in the construction of the levee being constructed by the Delta Lamar Improvement District No. 1. The district now has a channel machine in operation and a channel in North Sulphur River about nine miles long is being cut. With the additional machinery, a levee about 12 miles long will be built. The levees and channel, when completed, will reclaim about 7,000 acres of rich bottom lands at a cost of approximately $350,000, and will make one of the best agricultural tracts in the State.

Winners of Michigan U. Highway Fellowships Announced

The board of regents of the University of Michigan at its November meeting appointed the following to receive 1922-1923 fellowships in highway engineering and highway transport:

Roy D. Chapin fellow in highway transport, Major Mark L. Ireland, Quartermaster Corps, U. S. A.; 1901, B. S. and 1913, M. E., Michigan Agricultural College; 1921, M. S., Massachusetts Institute of Technology. Since 1904 Major Ireland has been an army officer.

Roy D. Chapin fellow in highway engineering, William J. Groves; 1920, B. S., University of Missouri. (Entered School of Arts and Sciences, University of Missouri, 1914-15, School of Engineering 1915-1918, U. S. Army, June 1918 to June, 1919, School of Engineering, University of Missouri, 1919-1920.) Mr. Groves is at present assistant county engineer, Fayette County, Texas.

Detroit Edison fellow in highway engineering, A. T. Bragonier; 1909 graduate of Normal Department, Shepherd College; 1916 B. S. C. E., West Virginia University. At present Mr. Bragonier is instructor in highway engineering, West Virginia University and an engineer with the West Virginia State Highway Department.

Detroit Edison fellow in highway engineering, John D. Slye: 1914, B. S. C. E., University of Colorado. Mr. Slye, since 1919, has been chief of road surveys, U. S. Bureau of Public Roads, Denver, Colo.

Port Authority Reaffirms Opposition to Newark Bridge

The Port of New York Authority has reaffirmed to the Secretary of War its position of opposition to the construction of a bridge by the Central Railroad of New Jersey at the mouth of Newark Bay from Elizabethport to Bayonne and urges the postponement of action by the War Department on the matter for at least two years. The Port Authority, in a letter to the United States engineer officer in New York, states that it will be not possible until two or three years have passed to foreshadow the development of Newark Bay as to marine traffic and that it would be unfair to possible Newark Bay traffic to set up across the lower bay a bridge which would impede such traffic.

Hearings are still under way at Washington in the matter of the bridge, which was authorized by federal law some years ago and which is now being opposed by the city of Newark. The railroad's authorization expires next Friday and it is now endeavoring to have the last date for commencing work put forward some years.

Army Engineers Visit Rio Grande

Army engineers have been sent to El Paso, Texas. to inspect the Rio Grande River between El Paso and Fort Quitman, Texas, with the view of passing on the proposed deepening and straightening of the river channel as a means of removing the flood and mosquito menace at El Paso. The project will involve the expenditure of millions of dollars, according to Major Adams, who is in charge of the inspection party.

Electric Generating Stations To Absorb Indiana Fuel Wastage

The proposal of the construction of electric generating stations at the coal fields, to absorb fuel wastage has taken definite form in the North Middle West.

In discussing the situation recently Walter P. Bloecher, of Stone & Webster, has the following to say:

"The electric power and lighting utilities of some seventy cities and towns in Central Indiana, with Indianapolis as a center, have been consolidated by the Central Indiana Power Co. All will be interconnected and operated more or less as a unit. A new power station, with initial capacity of 40,000 kw., will be constructed on the bank of the Wabash River and in the center of some 3,400 acres of proven coal lands which the company has acquired. The electrical requirements of something in excess of 500,000 people will be met by the system. Savings in fuel, in administration and general overall expense are set up as results which may be expected to flow from interconnection operation.

"The new power station will be designed and built by Stone & Webster construction forces under the supervision of Kelsey Brewer & Co., of Grand Rapids, managers of the new system, while the financing of the consolidation, with the station and necessary physical links, to the extent of approximately $12,000,000, will be handled by Halsey, Stuart & Co., Stone & Webster, Inc., Spencer, Trask & Co., A. B. Leach & Co., and Paine, Webber & Co.

Municipal Garbage Collection to Be Continued at Seattle

By a vote of 5 to 4 the city council of Seattle, Wash., recently decided against changing from municipal to contract collection of garbage. Motor-truck collection is to be tried. A proposal to shift the collection work from the health to the public works department has been made.

Bridge Over Tanana River Nears Completion

When the Tanana River freezes over solidly, the finishing touches will be put on the 705-ft. span being used on the Alaskan R.R. to bridge that stream. The approaches have been completed

ALASKAN RAILWAY BRIDGE ACROSS TANANA RIVER

and the falsework is all in awaiting the freezing of the river to complete the erection of the structure. It is believed trains will be using the bridge before the end of the year.

High Dam Conflict Awaits Legislative Action

Federal Power Commission Expected to Act Quickly Should the Minnesota Legislature Fail

Washington Correspondence

If the Minnesota legislature does not take action in the matter involving the use of the High Dam in the Mississippi River between St. Paul and Minneapolis, the Federal Power Commission is expected to act and quickly. The delay which has been occasioned by the conflict over who shall utilize the power which can be developed at that government dam, already has cost the Federal Government nearly $700,000. The matter has been further complicated by the filing of an application by Henry Ford.

The trouble was precipitated when the St. Paul Association, composed of leading citizens, induced their city to file an application with the Federal Power Commission for the right to develop the power which could be produced at the High Dam. This association is endeavoring to establish a new industrial area, and as a part of that campaign had secured the promise of Henry Ford to build a factory to employ 5,000 men on the understanding that the association would obtain power rights which it would transfer to him.

Conflicting Applications Filed

This action caused the Northern States Power Co. to file a conflicting application. Still another conflicting application was filed by the City of Minneapolis. The Federal Power Commission held a hearing, but at the request of Senator Nelson, a decision was delayed so as to give the Municipal Electric Corp., composed of the cities of St. Paul and Minneapolis and the University of Minnesota, an opportunity to obtain the necessary state legislation to construct and operate the power plant.

It is apparent to those who have observed the situation closely that there is no chance for the two cities to get together on any proposition. In the meantime it has become apparent that the Federal Power Commission hardly would grant a license in such an indirect arrangement as is involved in the city of St. Paul—St. Paul Association—Henry Ford proposal.

As a result of the government's large investment in the dam, it is known that federal officials are disposed to make a final settlement of this project just as soon as the Minnesota Legislature will have indicated its intention in the matter.

Colorado Engineers to Make Survey of State's Technical Schools

The Colorado Engineering Council will make a survey of the state's technical schools, according to Arthur Ridgway, president of the council. The council will endeavor to ascertain the adequacy of technical education to meet the demand of engineering practice.

Mr. Ridgway asserts that "the council desires above all things else to see educational standards so maintained and specialization so distinctly marked that our young men will begin their professional careers thoroughly equipped to cope with the intricate and constantly increasing problems of our advanced civilization."

Great Northern Power Has Extensive 1923 Program

Will Spend Between $5,000,000 and $6,000,000 on Extensions—Pharris New Chief Engineer

Extensions of the Great Northern Power Company's Duluth electrical development to be started during 1923 at an estimated ultimate cost of between $4,000,000 and $5,000,000 have been announced by officials of the company. Included in the company's program is an extension of the present power development at Thomson on the St. Louis River, 18 miles north of Duluth, from 80,000 hp. to 150,000 hp.

The development program provides for the building of an additional dam in the vicinity of Fond-du-lac, Minn., at a point where a 70-ft. fall is available. The water from the power house there will be used over again in the reservoir to furnish the supply for the new buildings to be built at the dam. Additional pipe lines will be from that power house to the head gates of the company's present development at Thomson.

The Fond-du-Lac end of the project is estimated to cost $1,500,000. With a 375-ft. fall from the main reservoir to the present power house and a 70-ft. fall contemplated at the new dam, it is believed sufficient power will be furnished to operate Duluth and Superior street railways, and for industrial and electric lighting use in those cities for years to come.

Arrangements for financing the development program have been made with the Electric Bond & Development Co., New York.

Le Roy M. Pharris, of Salt Lake City, Utah, has arrived in Duluth to take charge of the company's plants and proposed extensions as chief engineer. He will direct the development program to its completion under the joint direction of the Duluth corporation and the Electric Bond & Share Co.

All the property necessary to carry through the power development has been purchased and it is expected that a start will be made next spring upon the Fond-du-Lac dam.

Dearborn Terminal Station at Chicago Burns

A short but spectacular fire in the headhouse of the Dearborn terminal station at Polk and Dearborn Sts., Chicago, practically destroyed the building on Dec. 21. This prominent structure, built in 1884, had heavy walls of brick and stone masonry, including a tall tower, but the floors and roof were of timber framing which burned rapidly. The main trainshed and a brick annex of the headhouse were not damaged. As the fire occurred about 4 p.m. it interfered seriously with the heavy rush-hour suburban service, but suburban and main-line trains were operated from the yards just outside the station.

It is thought probable that the first floor of the main building can be utilized temporarily for passenger facilities until decision is made as to reconstruction, but the office portion of the building is gutted. This station, which is owned by the Chicago & Western Indiana R.R., is the terminal for several important trunk lines and has an exceedingly heavy business.

Five Central States Announce Engineering Society Meetings

The Michigan Engineering Society will hold its annual meeting at Muskegon, Mich., Feb. 7 to 9, 1923. An exhibit of appliances and supplies is to be one of the features. C. B. Huff, Detroit, Mich., is secretary.

The Engineering Society of Wisconsin will hold its annual meeting at Madison, Wis., Feb. 22 and 23, 1923. L. S. Smith, Madison, Wis., is secretary.

The Iowa Engineering Society will hold its 35th annual convention at the Chamberlain Hotel, Des Moines, Iowa, Jan. 23 to 26. It is expected that 400 engineers will attend, including electrical, mechanical, mining, municipal, county, and drainage and structural engineers; and there will be an exhibit in connection with the meeting. M. L. Patzig of Des Moines is secretary of the society.

The Indiana Engineering Society announces the place and time of its annual meeting as the Lincoln Hotel, Indianapolis, Jan. 18 and 19, 1923. The preliminary program includes the following papers: "The Bates Experimental Road" by Clifford Older, state highway engineer of Illinois; "Hydraulic Power Development on the Tippecanoe River" by R. N. Freeman, New York; "Power Plant Progress" by Prof. A. W. Cole, Purdue University; "The Engineer License Law" by C. W. Cole, South Bend, Ind.; "The Railroad and the Public" by C. W. Paquette, chief engineer of the C., C., C. & St. L. Ry. There will be an excursion to the new dam and automatic hydraulic power plant of the Noblesville Light & Power Co., at Noblesville, Ind. Charles Brossmann, Indianapolis, is secretary of the society.

The Illinois Society of Engineers will hold its annual meeting Jan. 23 to 25 at Peoria, Ill.

Texans Urge Passage of Flood Control Bill

Messages have been sent to Representative J. P. Buchanan at Washington by Governor Neff of Texas and John A. Norris chairman of the state board of water engineers, urging support of the appropriation bill for topographic and flood-control work in Texas now before the House Finance Committee, of which Mr. Buchanan is a member. The measure, it is said, will assist Texas in carrying out its flood-control program. Similar messages are being sent by others interested in the program.

Colorado Supreme Court Upholds Moffat Tunnel Commission

On Dec. 18 the Supreme Court of Colorado denied to opponents of the Moffatt Tunnel project an injunction seeking to restrain the tunnel commission from entering upon the tunnel's construction. Ninety days are allowed in which appeal may be taken to the U. S. Supreme Court. It is not known yet whether an appeal will be made.

B. H. Bryant: A Tribute

BY CHARLES HANSEL

Consulting Engineer, New York City

I hope that every engineer can look back along the years to the time when he started his creative work under the direction of his first chief and be profoundly thankful that circumstances led him to begin his life's work under a man that he forever after looked upon with the same respect and admiration that I have continuously felt for my first chief, B. H. Bryant, who died July 8, 1922.

The years are many since I first looked upon him at Alamosa, Colo., in 1879. and each year has added to my knowledge and appreciation of his great ability as a railroad location engineer; tireless in energy and thoughtless of self, always a gentleman, always an engineer. His professional achievements were so varied and so important that I shall not here attempt to mention more than a few outstanding achievements.

As locating engineer, Denver & Rio Grande Ry. from Espanola, N. M. to El Paso, Tex., he located and built 400 miles of road. Later he was constructing engineer for the Canadian Pacific Ry. on the Kicking Horse and Columbus Rivers, and locating engineer, for the Great Northern Ry., from Helena to Great Falls. As chief engineer, Colorado Midland R.R., in 1887, he built the Buck Tunnel, 9,400 ft. long, then the second longest tunnel in the world. He served as chief engineer of the Colorado Southern during 1904 and 1905.

Mr. Bryant's work was not limited to the States. He left the Colorado Southern to accept the position of chief engineer of the Sao Paulo and Rio Grande R.R., Brazil; and while in Brazil he located more than 1,000 miles of line. From Brazil he went to Mexico with Dr. Pearson, where he explored and located several hundreds of miles. From Mexico he journeyed to Central America, where as chief location engineer for the International Railways of Central America he located projected lines in Guatemala, Salvador and Honduras.

During Mr. Bryant's later years he lived in New York and it was my great privilege frequently to receive him at my office, where my staff and I saluted him as chief. His picture honors my offices and I daily look upon it with pride—pride in his splendid character, ability and achievements, pride in having my first chief the intimate friend of my later years.

He was a man; he kept a holy faith in God and man. Work was his happiness, achievement his compensation; he loved his profession, he was loved. This fills the cup of contentment. The longest life contains no more.

New Niagara Gorge Bridge to Be Built by Michigan Central

Plans have been completed by the Michigan Central R.R. for a new double-track bridge crossing the Niagara gorge at Niagara Falls, N. Y., alongside the existing cantilever bridge of the railroad. Contract for construction of the superstructure has been let to the American Bridge Co. Active construction is expected to be started early in the coming season.

Cowper Nominated A.G.C. President

John W. Cowper, president of the John W. Cowper Co., Buffalo, N. Y., was nominated by the Board of Directors of the Associated General Contractors as president of the association for 1923 at a special meeting in Washington, D. C., on Dec. 12. The new nomination was made necessary by the death by accident of W. E. Wood of Detroit, Mich., previously nominated. Mr. Cowper is a member of the advisory board of the A.G.C., chairman of the committee on contracts, and vice-chairman of the joint conference on standard construction contracts.

St. Louis Engineers Will Talk on Bond Issue Items

To help inform the public as to the needs and purposes of the works covered by the proposed $88,000,000 bond issue at St. Louis, Mo., the Associated Engineering Societies of St. Louis have undertaken to have a series of short addresses given by engineers specially familiar with the several subjects. There are twenty-one items to be voted on separately and there will be a talk on each of these items. The series will begin in January, as a preparation for the public vote on Feb. 9, 1923.

In addition to this, a special committee organized by the Chamber of Commerce, with Baxter L. Brown, consulting engineer, at its head, has prepared a pamphlet explaining the items of the bond issue and giving the distribution of cost for the different works covered by these items.

Rio Power Plant Visited by American Engineers

An excursion to Lages, the source of hydro-electric power for the city and the state of Rio de Janeiro and the federal district in general, was arranged by the Brazilian Club de Engenharia for the visiting American engineers at the international exposition held in Rio de Janeiro in October, writes V. L. Havens, editor of *Ingeniería Internacional*, who represented the Am. Soc. C. E. at the congress.

The Lages installation, 13 miles from Lages and 58 miles from Rio de Janeiro, was reached by the Central Ry. of Brazil. The working head at the time of this visit was 304 m. The load in Rio de Janeiro averages about 900,000 kilos a day, among 80,000 light and 4,000 power customers. An outdoor substation supplies the state of Rio de Janeiro and a small interior department of the power house distributes to the works and to nearby farms and towns.

The electrical equipment at the plant is chiefly Westinghouse, with some Escher-Weiss hydraulic equipment and eight Pelton wheels. One of the wheels was idle for a time, and it was noted that the badly worn buckets had been built up by electric welding and later ground smooth with abrasive wheels.

The party made a trip by mule to the dam, which is built on a radius of 100 m., is about 45 m. high and stores 210,000,000 cu. m. of water. The lake above the dam follows a narrow canon for nearly 20 miles and runs back into many tributary gulches.

Are There Any Other State Engineering Societies?

In collecting information for its proposed booklet of engineering society data, Engineering News-Record has so far recorded only twenty-three state engineering societies. These, under various styles of name, are in the following states: Arkansas, Colorado, Connecticut, Florida, Illinois, Indiana, Iowa, Kansas, Louisiana, Massachusetts (Western), Michigan, Minnesota, Montana, New Jersey, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Vermont, and Wisconsin. If there are any others, notice of their existence and data concerning them would be appreciated. Please address letter to Editor, Engineering News-Record, and give name of society, secretary, president, location of home office, date and place of next annual meeting, and number of members.

Contractors' Insurance Claims Valid; A.G.C. to Handle Cases

Claims of contractors who built cantonments and other cost-plus works for the War Department during the war and were not reimbursed for the money they paid as premiums for surety bonds and liability, hold-up and burglary insurance, may be handled direct or through the Washington headquarters of the Associated General Contractors of America, such claims having been declared legitimate by the U. S. Supreme Court.

Following the high court's decision in the test cases brought before it by Mason & Hanger and the North-Eastern Construction Co., in which the ruling of the Court of Claims was upheld, the A.G.C. perfected arrangements to handle such claims for its members.

The cases decided by the Supreme Court grew out of a ruling by the Comptroller of Currency that money paid for bonds and insurance premiums could not be charged by contractors against the government on cost-plus contracts. The War Department had made a number of payments of this character before the ruling was handed down. The contractors who had thus been paid reimbursed the government. However, most of these claims were never paid. The Court of Claims and now the Supreme Court held that the government is obligated to repay the contractors for such expenditures.

Claims aggregating between $2,000,000 and $3,000,000 are said to be outstanding under this classification.

Texas Plans Drainage Reservoir To Benefit 100,000 Acres

A project involving the construction of a reservoir at Bronte, Texas, that will hold 250,000 acre-ft. of water and drain approximately 100,000 acres of land situated in Coke, Brown, and Runnels counties, has been approved by the state board of water engineers, according to Chairman Norris of the board.

Hearing on Louisville Dam Is Set for January 22

Washington Correspondence

The Secretary of War will hear on Jan. 22 the arguments of representatives of each party to the controversy over the power which will become available with the completion of dam No. 41 in the Ohio River at Louisville. Contenders for this power are the city of Louisville and the H. M. Byllesby Co.

Both the War Department and the Federal Power Commission are anxious to have a decision reached in this matter, since the construction of the dam is being delayed pending the outcome of the controversy. The appropriation necessary for the construction of the dam is available to the Chief of Engineers. It is felt that the successful applicant should co-operate with the district engineer in the preparation of the designs for the dam so that the maximum utilization may be made of the 35 ft. of head which will be developed.

The plan whereby the city of Louisville expects to make use of this power was worked out by the chief engineer of the city water-works. The city officials have been interested sufficiently to retain General William L. Sibert to investigate the proposition for them.

It is believed, however, that the city cannot make full utilization of the power unless it is prepared to take over the steam plant and distribution system of the Louisville Gas and Electric Co. Furthermore, Louisville probably cannot secure rights to own property and do business in Indiana. Indiana has the right to utilize one-half of the power which the dam will make available. Since the city is not in a position to make full utilization of the power, it is anticipated that the Federal Power Commission will decide the case in favor of the Louisville Hydro-Electric Co., which is the Byllesby subsidiary, and the actual applicant.

Report on Dirigible Design

A technical committee to report on the design of the U. S. Navy dirigible ZR 1 has made a preliminary report indicating that the design is satisfactory. This conclusion is specially reassuring because the vessel is rather similar in design to the British dirigible R 38 (American number ZR 2), which failed while flying over the Humber River. The committee, composed of Henry Goldmark, New York, as chairman, and W. W. Pagon, Baltimore, as secretary, both civil engineers, and Prof. William Hovgaard, Boston, Dr. L. B. Tuckerman, Bureau of Standards, and Dr. M. M. Munk, of the National Advisory Committee for Aeronautics, is expected to render a final report within a few weeks, having been engaged in the investigation since June. Its preliminary statement says that in the design of the vessel all available information on the subject has been applied with good judgment; that the quality of materials used and the methods of construction are satisfactory; that the strength of individual parts has been demonstrated by tests; that the vessel is stronger than the R 38; that the reasons for the failure of the latter have not been definitely established (by the British report); and that the design of the ZR 1 contains careful provision for possible causes of failure other than structural weakness.

Erie County, New York, Appoints Traffic Engineer

Erie County, N. Y., the county in which Buffalo is located, is to have a traffic engineer. George C. Diehl, county engineer and also president of the American Automobile Association, has been urging the establishment of a department in traffic engineering in his county for a number of years. His efforts have finally brought about the appointment of Howard H. Parsons as traffic engineer for the county.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7 to 9, 1923.

The San Francisco Section, Am. Soc. C.E., held its annual meeting on Dec. 19 and elected the following officers for the ensuing year: President, George A. Elliott, chief engineer, Spring Valley Water Co.; vice-president, H. H. Wadsworth, consulting engineer; secretary-treasurer, Henry D. Dewell, consulting engineer. The paper of the evening was read by Frank G. White, chief engineer, state Board of Harbor Commissioners, on "The China Basin Terminal."

Personal Notes

H. Burdette Cleveland, for the last three years secretary and consulting engineer of the Barth Engineering & Sanitation Co., and before that for fourteen years principal assistant engineer New York State Department of Health, will become associated with C. C. Vermeule, consulting engineer, New York City, on Jan. 1. Mr. Cleveland will devote himself to water supply and purification, sewerage and sewage treatment.

R. M. Cooley, for ten years a member of the engineering staff of the Minnesota State Highway Department, St. Paul, except for fourteen months spent in France during the World War with the 33rd Engineers, has resigned to represent the Holt Manufacturing Co. in Minneapolis. J. T. Ellison, assistant highway commissioner and chief bridge engineer, has assumed the bulk of Mr. Cooley's duties as superintendent of equipment for the highway department.

F. M. Mann, head of the department of architecture in the College of Engineering and Architecture, University of Minnesota, has been appointed a member of the Minneapolis City Planning Board.

Lieut.-Col. George B. Pillsbury, Corps of Engineers, U. S. Army, has been awarded a Distinguished Service Medal for exceptionally meritorious and distinguished service as an engineer officer. A similar decoration has been awarded to Lieut.-Col. John P. Hogan, of the Officers' Reserve Corps, for services as chief of the topographic sections of the Fifth Army Corps and of the Second Army in France. A similar decoration was awarded Major Howard S. Bennion, Corps of Engineers, for his services in organizing and placing the camouflage service on a high basis.

David A. Decker, engineer of water and sewers, Norfolk, Va., has resigned to accept a position with the Lock Joint Pipe Co., of Ampere, N. J. His first work will be the construction of 52 miles of reinforced-concrete pressure pipe for this company at Tulsa, Okla. With the completion of this work he will represent the company in the South. He has just completed the construction of the Lake Prince water supply project for Norfolk, at a cost of approximately $4,000,000, and in addition to this has had charge of all water-works and sewer construction and maintenance in that city. He has been with the Norfolk Department of Public Works since 1911, with the exception of ten months in 1917, when he resigned to enter private work, but was recalled in January, 1918, during the war, to take charge of water construction.

W. D. Barkhuff has been appointed by the Board of Public Works as superintendent of streets and sewers of Seattle, Wash., following the recent resignation of Lt.-Col. George M. Rice. Mr. Barkhuff is a civil engineer, having served as district engineer in the city engineering department from 1908 to 1911.

A. N. Johns, who for the past several years has been connected with the engineering department of the California State Railroad Commission, has severed his connection with that organization to take the position of chief engineer with the Associated Telephone Co., of Long Beach, Calif.

G. I. Batelle, formerly with the engineering department of the city of San Francisco; Charles Worden, of the firm of Lloyd and Worden, Quincy, Calif., and E. W. Roberts, formerly with the Western States Gas and Electric Co., are now in the employ of the California State Highway Commission.

J. R. Vernon has resigned his position as assistant division engineer for the Wisconsin Highway Commission at Lancaster, Wis., and has accepted a position in the Chicago office of the Johnson Service Co.

The Thompson & Lichtner Co., engineers, Boston, announce the addition to their firm, as partners, of W. Burton Wescott and Frederick F. Bryant, both formerly of the firm of Kalmus, Comstock & Wescott, Inc., Boston, and Ernest R. Sharpe, formerly of the Industrial Service Department, Boston.

The Highway Construction Co., Elyria, Ohio, has been incorporated with a capital of $250,000 to do general construction work, the incorporators being M. Mendelson, Fred E. Altfelt, H. C. Cheney, F. L. Hamel, and L. B. Fauver.

Robert Jemison, Jr., of Birmingham, Ala., has been appointed a member of the Alabama Highway Commission to succeed S. R. Batson, who resigned in order to devote his entire time to private practice. Mr. Batson was for many years county engineer of Jefferson County, Ala.

C. W. Best, Canonsburg, Pa., who has been a structural detailer with the McClintic-Marshall Construction Co., has taken up the same kind of work for the Fort Pitt Bridge Works.

F. W. Ward has been made superintendent of construction for the H. P. Cummings Construction Co., Ware, Mass., after having worked for the Fitzdale Paper Co. in the same capacity.

Robert D. Short, formerly concrete designing draftsman with the Kentucky Highway Department, is now concrete designer for the Sinclair Refining Co., an oil refining firm in Chicago.

Richard J. Hale has been appointed county engineer of Missoula County, Mont. He was formerly engineer with the Pioneer Construction Co.

Major Virgil L. Peterson, of Providence, R.I., has been awarded a Distinguished Service Medal for his work, as Colonel of Engineers, in reorganization training at Camps Lee and Humphreys, Va.

Obituary

Harold Howald, city engineer of Massillon, Ohio, was burned to death at Little Wadsworth, Ohio, in a fire which destroyed a cottage near the west reservoir. Mr. Howald had been city engineer of Massillon for ten years.

Frank S. Taylor, consulting engineer of Austin, Texas, died at his home Dec. 15 from the effects of a stroke of apoplexy suffered a few days previous. He was 54 years old. Mr. Taylor was born in San Antonio, Texas, and resided for the greater part of his life in Austin. He was a graduate of Vanderbilt University.

George Sears Greene, Jr., former director, treasurer and vice-president of the American Society of Civil Engineers, and a consulting engineer of New York City, died at his home in South Orange, N. J., Dec. 23, at the age of 85 years. Mr. Greene was prominent in the early engineering development of New York's port, having been in charge, as chief engineer of the Department of Docks, of building the sea-wall which partially surrounds the Island of Manhattan. An extended obituary will be published in next week's issue.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

The following article amplifies some of the points regarding cement production, prices, and seasonal demand discussed by L. R. Burch, of the Atlas Portland Cement Co., in "Engineering News-Record" Sept. 14, p. 456 and Sept. 7, p. 404.—Editor.

Cement Producing Capacity in United States Is Ample

Seasonal Demand, However, Restricts Output of Mills to 80 per Cent of Maximum

By Blaine S. Smith
General Sales Manager, Universal Portland Cement Co., Chicago

DIFFICULTY in securing cement through the summer and fall of this year was due not only to the coal and railroad strikes, but to other reasons that applied this year and in many previous years. Purchasers demand large shipments of cement in summer and fall and decline to take deliveries in winter and spring. As a result, cement mills are idle or run only part time in the former season and are unable to produce enough to supply the demand in the latter season. Transportation usually is available in winter and spring, while the railroads are congested in summer and fall. Obviously the cement user's remedy is to order out shipments when cement and transportation to move it are available.

The cement manufacturing capacity of the country is from 130 to 140 million barrels a year. The country, however, has never used in any year prior to 1922 as much as 100 million barrels. The country fails to use as much as 80 per cent of its manufacturing capacity, even in a year of abnormal building activity, because, to a large extent, cement is considered a seasonal product.

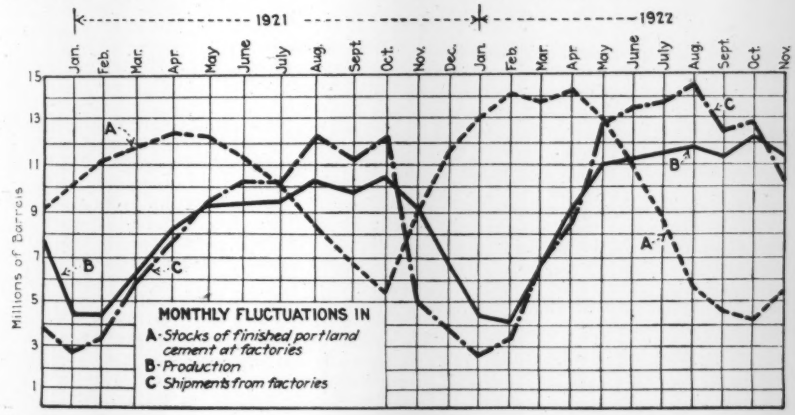
Mills, therefore, manufacture and store large quantities of cement in the off season to be able to ship more than can be produced in the busy season. One manufacturer with a mill capacity of 12 million barrels a year, had in storage the latter part of April more than 4 million barrels, or over a third of a full year's output. This practice, of course, involves a very heavy investment by the manufacturer which of necessity is reflected in the price of his product.

Aside from this important feature, there is another of equal importance. The average cement mill operating at capacity will fill its storage space in about three months if it makes no outgoing shipments. All mills, of course, make some shipments in all months of the year but shipments through the winter and early spring are usually so light that storage bins becomme full, necessitating curtailment of production. In a year of ordinarily heavy demand for cement production lost by a cement mill in the early months is lost forever.

To illustrate: A mill with a producing capacity of 12 million barrels a year can produce a million barrels a month—and no more. If it loses a month's production from any cause it cannot the next month make up the loss by producing 2 million barrels. This year one manufacturer lost upwards of three-quarters of a million barrels of production in August and September because of the coal strike. When this manufacturer's mills later began to receive sufficient coal for full operations the mills could not make up the lost production because even at full operation they were not capable of turning out more than a million barrels a month. Their shipments were 2 million barrels in July and nearly as much in August, although in the latter month a large part of their producing capacity was shut down because of lack of coal. The heavy shipments were made from stocks produced in earlier months.

All this means that while the capacity of the country's cement mills is more by 20 to 30 per cent than the

(Concluded on page 1140)



More Suggestions—

For Better Equipment and Repair Parts Service

IN THE Dec. 14 issue was begun a discussion of "Better Equipment Maintenance and Repair Parts Service." Its object is to show how some of the misunderstandings between maker and user of construction machinery can be avoided. This week's contribution is a recital of experiences by a manufacturer of air compressors and pneumatic tools:

Sullivan Machinery Co., Chicago

OUR instructions to customers, printed in our part lists and instruction books, read as follows:

> *Always give the name of the part desired, the number stamped or cast on it, and the name, type and shop number of the machine on which it is used. With these identification marks before us, we shall be able to fill your repair orders promptly and without confusion.*

If we can get the customer to give us this information everything is lovely. In the case of certain machines, particularly those having a large number of parts, we have found it more convenient to use a reference number on a chart or group photograph of parts and the customer orders by the reference number, or by the telegraph code word identified with it, if he prefers. In every case we keep an exact duplicate part list corresponding with the machine which the customer has, and this list is referred to in making out repair orders which come in in this way.

Proper Repair Stock Base

We find that most customers do not know what a proper repair stock base is for their machine. This base varies with the number of machines which a customer has in use, the likelihood of breakage or wear requiring replacement, also with the size and expense of the part.

The troubles here discussed are old ones with us, and yet, in spite of all our pains, they keep recurring.

NOTICE

Please keep the enclosed detail part list in a prominent place where it can be easily referred to. When ordering duplicate parts for the machinery recently sent you, **USE THIS LIST** and give the following data, which will enable us to fill your order promptly and without mistakes:

1. Symbol letters and shop number of machine.

2. Name of part and piece number stamped or cast on part to be replaced.

3. State whether machine uses steam, air or electricity.

Sullivan Machinery Co.
Form 1228

We ship a book of instructions with each machine and a repair part list which is either a group photo list or an outline cut of the machine with arrows and reference numbers.

In addition, when the customer's part list is sent to him, a label is attached to it in such a way that it can hardly be overlooked. The part list should be placed in the hands of the proper clerk who has to do with ordering.

If we could get the acceptance of the idea of keeping proper stock of repairs on hand it would eliminate many troubles. The larger concerns are more intelligent about this than the smaller ones.

A tendency which has to be combatted is that of carrying too many repairs on hand. Machine design changes, and it is dangerous to carry too large a stock, as well as to carry too small a stock of parts. Manufacturers are not very receptive when they are asked to take back several hundred dollars worth of repairs which a customer has been cherishing on his shelf for eight or ten years, and which are for machines no longer built. This could be avoided by keeping suitable stock bases. Manufacturers' salesmen and engineers are always ready to indicate what adequate and safe bases are.

Further comment on better equipment maintenance and repair parts service will appear in an early issue.—EDITOR.

Cement Production

(*Concluded from p.* 1139)

country has ever used, it is impossible to utilize it.

The U. S. Geological Survey issues monthly statistics on cement production, shipments and stocks. Commenting on these statistics for August the Portland Cement Association says:

"That the portland cement industry has capacity sufficient to take care of a very marked increase in construction activity is evidenced by U. S. Geological Survey production figures for August and preceding months this year.

"Notwithstanding the inability of some companies to secure coal, which is a very important item in the cement manufacturing process (200 lb. of coal being required for manufacture of each 376-lb. barrel of portland cement), August was the best production month on record—11,664,000 bbl. being produced. This is the fourth successive month in which production has exceeded 11,000,000 bbl., and that figure had never heretofore been exceeded.

"Total production since the active construction season opened on April 1 has been approximately 55,000,000 bbl., or at the rate of 132,000,000 bbl. per year. Shipments for the best previous year on record totaled slightly under 100,000,000 bbl."

The rate of 132 million barrels a year is based on the average production of 11 million barrels a month for the five months beginning April 1, as reported by the Geological Survey. A further analysis of the Survey's figures shows stocks on hand at the beginning of the year about 13 million barrels and production in the first three months of this year 15¼ million barrels, some 17 to 18 million barrels short of the productive capacity of 11 million barrels a month for the following five months. If shipments in January, February and March had been at a rate sufficiently high to have permitted the production of all or a substantial part of the 17 or 18 million barrels just referred to, that quantity of cement would have been available later at a time of so-called cement shortage or would have been used in work earlier in the year thus reducing the later demand which was beyond the ability of cement mills to satisfy.

Still further analysis of the Geological Survey's figures shows that production up to the end of April was about 24½ million barrels, which added to stocks on hand at the beginning of the year of about 13 million barrels gives a total of about 37 million barrels available for shipment in the first four months of the year. Actual shipments in those four months were less than 22 million barrels, an excess of available cement over shipments of about 15 million barrels. For the next four months, from May 1 to Aug. 31, production was about 45½ million barrels and shipments about 54½ million, an excess of shipments over production of about 9 million barrels. In other words, purchasers took from cement companies in the first four months considerably less cement than was manufactured and a great deal less than the country's mills were capable of manufacturing. In the next four months they took more cement than was manufactured, a practice made possible by the fact that manufacturers carried in stock at the beginning of the year about 13 million barrels and produced in the first four months considerably more cement than purchasers allowed them to ship.

EFFECT OF REGULATION

Regulation of production, therefore, is most important in its effect on the cement purchaser who, unable to secure all the cement he wants in the late summer and early fall months, forms the opinion that the cement manufacturing capacity of the country is insufficient to supply the country's needs. That opinion is incorrect, as demonstrated by the Geological Survey's figures.

The next most important feature entering into the situation is transportation. It is a well known fact that in years of even normal business activity the railroads have difficulty in late summer and early fall in moving the traffic offered them, and in years of more than normal business activity the transportation system suffers an almost complete breakdown. In these conditions, it is clear that cement users cannot hope for as prompt deliveries in the late months as in the early months of the year. Yet they insist on demanding heavy shipments in summer and fall when deliveries are difficult to get because of lack of transportation facilities, and decline to take deliveries in winter and spring, when transportation is available.

Realizing the situation as affected both by production and by transportation, the Illinois State Highway Department is incorporating the following provision in its contracts with contractors who are to build roads next year:

Storage of Cement—It is understood and agreed that the contractor shall store during the months of January, February, March and April, 1923, not less than thirty-three and one-third (33⅓) per cent of the total amount of cement needed to complete this section, and that this rate of storage shall be maintained until the completion of the work, or until the end of the construction season of 1923.

Indiana also is incorporating a similar provision in its agreements with contractors. The highway departments of these two and other states have learned from bitter experience that they and their contractors cannot hope to carry out their extensive highway-building programs each year if they insist on trying to confine shipments of cement to the five months June to October inclusive, and decline to take out any cement in the remaining seven months.

Nor can the state highway departments alone, even if all the other states follow the lead of Illinois and Indiana, provide all the relief necessary. They can improve the situation vastly, but not relieve it entirely. The help of all other cement buyers also (dealers, railroads, industrial plants, contractors on both public and private work, all branches of federal, state and municipal government, etc., etc.) is needed.

Existing cement mills are amply able to supply the country's needs but they must be allowed to ship their output with some degree of regularity through all the months of the year. If more cement mills are built to supply the peak load in five or six months and remain idle or partly so in the other six or seven months it is inevitable that the price of cement will be higher than if the industry were conducted on a more businesslike basis. A mill running only part time cannot produce cement as cheaply as one operating continuously. The excess cost must be passed on by the manufacturer to the dealers in and users of cement.

Next Week

Review of the developments, during 1922, in the field of Construction Equipment and Materials.

Business Notes

FRED A. MARSH, general purchasing agent of the Link-Belt Co., Chicago, died in that city Dec. 11.

Mr. Marsh, who was 52 years old, had been a member of the Link-Belt organization for over 33 years; was one of the organizers of the Purchasing Agents Association of Chicago and served as its first president; and had been for years a director in the National Association of Purchasing Agents.

W. L. ALLEN has resigned as vice-president and general manager of Laclede Steel Co., St. Louis, Mo., to become associated after Jan. 1 with Frank H. Johnson of Chicago, Ill., in the sale of the Laclede and other steel companies' products. Mr. Allen was formerly

president of the Valley Steel Co. of East St. Louis, Ill., which was taken over by the Laclede company in 1918. He was one of the early sales engineers of the armor plate department of Carnegie Steel Co. in the promotion of chrome-vanadium and alloy steels. He later acted as commercial engineer of the R. D. Nuttall Co. in the development of heat-treated gearings.

RICHARD H. CATLETT, formerly New England representative of the Cal Chemical Co., Inc., Hagerstown, Md., has been made general manager of that company and transferred to Hagerstown. The company will be represented in New England by William S. Simpson, Inc., distributors, Boston.

T. W. LACKIE, superintendent for the Texas Bitulithic Co. at Paris, Texas, for a number of years, is now superintendent for the West Texas Construction Co. at Abilene.

Equipment and Materials

Truck Specially Equipped for Electric Line Repair

For service on electric line repair, cable pulling, erection of poles, and general construction maintenance work, the International Motor Co., New York, has provided special equipment for its 5 and 3½-ton Mack motor trucks. One of these units is in service for the Flatbush Gas Co. of Brooklyn, N. Y. Along the sides of the body are box compartments for holding materials, such as insulators and other parts ordinarily employed in work of this sort, in addition to locker compartments for the clothing of the workmen, and a special compartment for a gas furnace plant. Underneath the floor of the truck are box compartments for heavy tools, such as crowbars, shovels, pick-axes, etc. Supports are furnished also for carrying along the side of the truck 10-ft. ladders.

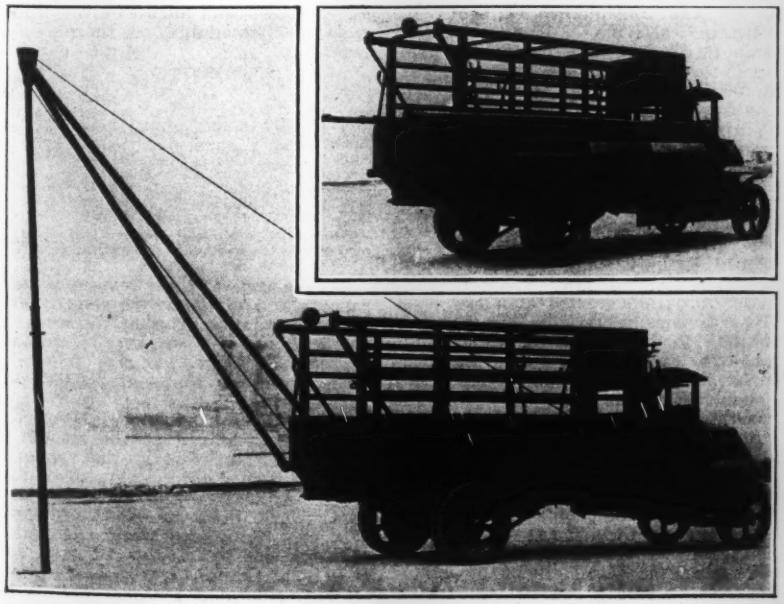
One of the features of the equipment is a demountable derrick, shown in the accompanying photograph, which consists of steel tubing forming an A-frame with a vertical support as shown. This equipment is employed for erecting poles, power for hoisting being supplied by the motor truck engine. This derrick has a capacity of 3,000 lb.

Portable Air-Electric Device Drills Concrete or Stone

For drilling or chipping concrete or stone a portable drill operated by a combination of electric and compressed air power has been developed by the Pneumelectric Corp., Syracuse, N. Y. It is intended particularly for contractors, electricians, plumbers, steamfitters, and millwrights. According to statements of its manufacturer, this machine has drilled a 1-in. hole 10 in. deep in a concrete ceiling in 3 min. 22 sec. for the purpose of suspending an electric motor.

The drill is of the hammer type, striking 1,000 blows per minute and the drill steel is rotated 100 r.p.m. by positive drive from the motor. When used for chipping purposes the rotating gear is removed. The hammer is operated by air expanding in the same cylinder in which it is compressed. The motor is inclosed and when working in an upright position a dust guard and jacket are used to protect the machine from the drill cuttings. The drill weighs 56 lb.

All parts are machined and gears are of alloy steel, heat-treated, with cut teeth. The air cylinder is an aluminum casting bushed with a steel sleeve.



Publications from the Construction Industry

Rock Crushers and Screens—SMITH ENGINEERING WORKS, Milwaukee, in a 26-p. bulletin, illustrates and describes its line of rock-crushing and gravel-pit machinery. Several new sizes of Telsmith primary breakers are shown, ranging in rated hourly capacity from 12 to 325 tons. A new size of reduction crusher with a rated hourly capacity of from 30 to 45 tons with discharge openings of from 1 to 1½ in. is listed. In the Telsmith rotary screen there has been introduced a renewable steel tracker ring and angle-iron frame. Similar changes have been made in the heavy-duty washing screen and a new 24-in. size has been added. There is also announced a new line of sand-settling tanks with improved tilting discharge designed to produce a dewatered product.

Deaeration of Water—H. S. B. W.-COCHRANE CORP., Philadelphia, discusses the deaeration of water to prevent corrosion in piping, economizers and boilers, in a 15-p. booklet. The apparatus described is designed to deliver water free of dissolved oxygen, at any temperature from 140 deg. F. up, as required for hot water heating and service systems and for feeding to economizers and boilers. The method consists in heating the water by spraying in a chamber under vacuum and then vigorously agitating or scrubbing the water by blowing steam through it.

Charts are given showing the amount of iron converted into rust by water containing different amounts of oxygen, vapor pressures corresponding to water temperatures and solubilities of oxygen and nitrogen in water at various temperatures and pressures. The Winkler test for detecting dissolved oxygen in water is also described.

Trench Machine—POTTER MANUFACTURING CO., Indianapolis, Ind., features its trench machine for sewer work in a 20-p. illustrated pamphlet. The equipment consists of a carriage which operates on a track supported above the trench by steel bents, forming a long trestle. Power for operating the equipment is supplied by a hoisting engine at one end of the trestle. Buckets for the excavated material are handled from the overhead carriage. The pamphlet contains a number of photographs of the trench machine in operation on contract work.

Steel Conveyor Belts—SANDVIK STEEL, INC., New York, in a 24-p. illustrated booklet, describes its steel conveyor belts which are manufactured in one-piece lengths of from 250 to 325 ft. and various widths and thicknesses. The belts may be arranged to run either on roller supports or to slide on wood runners. The steel belt, it is pointed out, cannot be troughed in the same manner as a textile belt, but, for non-abrasive material the conveying strand may be made the bottom of a trough, with fixed sides ⅛ in. clear of the belt, the carrying capacity being increased thereby from three to four times that of ordinary flat belt.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Industrial Activity Nears 1919 Peak Level

Production and Car Loadings Increased —Fewer Business Failures—Stronger Foreign Exchanges

In its ninth bi-monthly review of industrial-economic conditions in the United States, just issued, the National Industrial Conference Board says:

The recovery of business in the United States since the severe depression late in 1920 and early in 1921 has been unusually rapid, and industrial activity today is fast approaching the level at the peak of the boom of 1919-1920. General business is probably not quite up to this point, but the general situation is sound and far better than could have been reasonably expected at the beginning of 1921 or even at the beginning of 1922.

The business and industrial situation as a whole has shown a remarkable degree of improvement since the slump of 1920 and 1921. An index of industrial activity compiled by the National Industrial Conference Board and including seventeen of the principal basic industries of the United States showed that, compared with the monthly average for 1919-21 as a base, industrial activity for the month of October stood at 124.8. This compares very favorably with 65.7, the index number for January, 1921, and the low point since the beginning of 1915. The peak was reached in October, 1919 and the high point for 1922 so far was reached in June, when the index stood at 119.9.

Fundamental Conditions Sound

This index of industrial activity shows that the index rose 10 per cent from September to October and was 22.6 per cent higher in October, 1922 than in October, 1921. These facts indicate that industry has recovered much more rapidly than is generally supposed and that it is now at a very high point. In fact, it has been higher only on two occasions, namely, in July, 1918 and during the after-war boom in 1919 and 1920.

During October and November there was a steady improvement in the industrial situation. Fundamental conditions have become more sound. The evidence of this is to be found in those indices which are commonly accepted as measuring business conditions. The production of pig iron and steel ingots has increased, and during October it reached the highest point since the beginning of 1921. The unfilled tonnage of the United States Steel Corporation also rose considerably, indicating that even the increased production of iron and steel during October is by no means keeping pace with demand, which continues at a high rate. Commercial failures have decreased. Railroad car loadings have reached almost record-breaking figures; in fact, car loadings for the first ten months of 1922 are higher than for any similar period.

Prices have somewhat advanced and the tendency during the past two months, has been slightly upward. Wholesale prices have increased appreciably and in most lines seem to be firm and strong. Prices of staple raw materials have shown a considerable advance. Retail prices, however, have not as yet reflected the increase in wholesale prices and, with the exception of those of coal and food, remain almost stationary.

The agricultural crops of the country are larger than usual. Prices, however, except for cotton, are relatively low. As a group, prices of agricultural products have advanced less beyond pre-war levels than prices of any other of the principal commodity groups. This condition has caused criticism and unrest in agricultural sections of the country, where it is felt that the general prosperity of the industrial districts has not been shared.

Coal Output Normal

During October and November the coal industry again developed production to the normal amount. The danger of a serious coal famine seems past, though there may be some difficulty in distributing adequate supplies for domestic use, particularly of anthracite. Prices, however, are high and business is paying heavy toll for the recent discord in coal mining.

Money conditions have been characterized by relatively low rates of interest and re-discount, large availability of credit, increased specie reserves, and continuance of heavy investment activity. The increasing strength displayed by some of the principal foreign exchanges may be explained partly by the fact that absorption by American investors of foreign securities, both governmental and private, amounted to $653,000,000 during the first half of 1922, compared with $626,000,000 during the whole of 1921. The growth of commercial loans of banks and expansion in note circulation are due rather to an increase in fundamental business than to the seasonal demand of agriculture.

Foreign trade is still at a low level. Exports consist largely of raw materials, foodstuffs, and staple commodities, and those of highly manufactured merchandise are much restricted. Considerable quantities of coal and iron have been imported from abroad, but such imports are scarcely normal and with the increased production of coal and improvement in transportation, will probably largely decline.

The Near East problem continues to unsettle the international situation and has probably had some part in discouraging the development of export business.

Financial Situation

Stocks active in a professional way, with little trading by the public.

Bond market dull.

Money market quiet and steady. Demand loans on the stock exchange varied from 4 to 5 per cent, compared with 3½ to 5 per cent the week before. Time money remains at 4½ to 5 per cent.

Steel Fabricating Shop Capacity Increased Since 1913

A considerable increase in the capacity of the structural steel fabricating shops of the United States since 1913 is shown in a special survey made by the Department of Commerce. A preliminary report, based on data received from 143 firms with a total revised capacity rating of 208,440 tons per month, shows an increase since 1913 of 45,025 tons in monthly capacity, or about 22 per cent.

The following table shows the total monthly capacity for each year as reported by the above firms, representing about 83 per cent of the present estimated capacity of the United States, and the increase over the preceding year and over 1913:

	Total Monthly Capacity	Increase over Previous Year	Increase over 1913
1913.....	163,415		
1914.....	164,265	850	850
1915.....	166,500	2,235	3,085
1916.....	170,900	4,400	7,435
1917.....	175,935	5,035	12,520
1918.....	185,060	9,125	21,645
1919.....	188,800	3,740	25,385
1920.....	194,675	5,875	31,260
1921.....	197,575	2,900	34,160
1922.....	208,440	10,865	45,025

The increase noted in the year 1922 was largely due to the entrance of ship-building concerns into the fabrication of structural steel. In this connection, the Department of Commerce points out that the capacity of structural steel shops is quite elastic in that, when not busy on structural steel, a shop is often used for tank work, railroad cars, shipbuilding, etc., and, similarly structural work may be turned out in tank shops, shipbuilding plants, etc. The capacity figures given in the report refer to that portion of the fabricating capacity that is usually used for structural work; it is capable of expansion or contraction.

The following table shows the tonnage booked each month by these firms and the percentage of their revised capacities:

	Tonnage Booked	Per Cent of Capacity*
April.....	193,520	91.5
May.....	173,588	82.1
June.....	154,770	73.2
July.....	143,907	68.0
August.....	146,621	69.3
September.....	137,485	65.0
October.....	121,150	57.3
November.....	99,040	46.8

* Increased percentages over previous reports for past months due to revision of capacities.

On the basis of these revised capacity reports and of known or reliably estimated capacities of other concerns, the Department of Commerce places the present capacity of the fabricated structural steel shops at 250,000 tons per month.

The capacity as reported for this survey was defined as the amount of structural steel work that actually could be turned out running single turn on the character and class of structural work that the plant ordinarily secures. Structural work was considered for this purpose as all work uses structural shapes.

A considerable seasonal decline oc-

curred in the sales of fabricated structural steel in November, according to reports received by the Department of Commerce through the Bureau of the Census. November sales amounted to 46.8 per cent of shop capacity as against 57.3 per cent reported for October.

These percentages are based on a uniform capacity rating recently reported to the Bureau by almost all the reporting fabricators. Through these new ratings, the total monthly capacity of the 140 identical firms reporting each month from April through November has been reduced from 223,685 tons to 211,510 tons.

Wholesale Prices Rising

The trend of wholesale prices of commodities was upward in November, according to information gathered in representative markets by the U. S. Department of Labor through the Bureau of Labor statistics. Measured by the Bureau's weighted index number, which includes 404 commodities or price series, the increase from the general level of the month before was 1½ per cent.

Farm products again lead in price increases, due to advances in grains, cotton and cottonseed, wool, etc. Prices in this group averaged 3½ per cent higher in November than in October. Food articles and cloths and clothing advanced over 2 per cent and chemicals and drugs advanced almost 2½ per cent in average price from October to November. Smaller increases were recorded for building materials, housefurnishing goods, and miscellaneous commodities.

Further decreases took place in the group of fuel and lighting materials, soft coal and coke averaging less than in the month before. Metals and metal products, due to the drop in pig iron and steel billets, also showed a decline from the October level.

Of the 404 commodities or series of quotations for which comparable data for October and November were obtained, increases were shown in 189 and decreases in 71 instances. In 144 commodities no change in price was reported.

INDEX NUMBERS OF WHOLESALE PRICES BY GROUPS OF COMMODITIES
(1913=100.)

	1921	1922	
	November	October	November
Farm products	121	138	143
Foods	139	140	143
Cloths and clothing	180	188	192
Fuel and lighting	197	226	218
Metals and metal products	114	135	133
Building materials	163	183	185
Chemicals and drugs	129	124	127
Housefurnishing goods	178	176	179
Miscellaneous	119	120	122
All commodities	141	154	156

Comparing prices in November with those of a year ago, as measured by changes in the index numbers, it is seen that the general level has increased over 10½ per cent. Farm products show the largest increase, 18¼ per cent, with metals and metal products coming next with an increase of 16¾ per cent. Building materials increased 13¼ per cent, fuel and lighting materials 10¾ per cent, and cloths and clothing 6¾ per cent in average price in the year. Foods and miscellaneous commodities each show an increase of over 2½ per cent. A slight increase is shown for housefurnishing goods, while chemicals and drugs were cheaper than in November of last year.

Change in Examination of Immigrants Proposed

Selection of immigrants seeking admission to the United States by examination before they leave their foreign home countries was proposed by Secretary of Labor Davis in a recommendation which would revolutionize the present system of immigration examination, as set forth in the Secretary's annual report recently made public. Secretary Davis declared that the present system gives to foreign nations the privilege of selecting the immigrants whom they will permit to come to the United States.

The Secretary stated, in part, that "the passport system at the present time is, with reference to immigration, ill adapted to our needs. It is time that we ourselves had something to say—if we are to continue to rely upon alien labor for the development of our resources—about the kind of emigrants to be given the privilege of taking part in our national affairs. Instead of accepting the passport given by foreign Governments we should set a standard. Those qualified to enter should be selected on the other side and given our certificate of qualification. To accomplish this purpose legislation should be enacted providing for the examination abroad of prospective emigrants by giving the following tests:

"1. Blood: To determine the general condition of health, latent diseases, etc.

"2. A physical inventory of the strength and condition, brawn and muscle, affecting ability to earn a living.

"3. Mental: That our public institutions may not be filled with men, women, and children to whom we owe no national duty, while our own are not properly cared for; but further still, that our good American blood shall not become polluted with imbecility, insanity, and idiocy. We must keep the American race sturdy in mind as well as in body."

Texas Highway Contracts Reach Two Million in Three Months

Approximately $2,000,000 worth of paving contracts have been let during October, November and December for construction of state highways between San Antonio, Texas; points on the Rio Grande River and on the Gulf Coast, according to T. R. Spence, division engineer of the State Highway Department, in charge of State District No. 6, in which San Antonio is located. Contracts let during the week of Dec. 22, called for construction of twenty-five miles of highway in Medina County by the Kuykendall & Shelton Company of Temple, Texas, at a cost of $149,388.15; and building of two miles of road in Atacosa County, at Lytle, Texas, by the C. M. Kelly Company of San Antonio, at a cost of $16,348.32. Both contracts call for grading, graveling and drainage work. Completion of the Medina County construction will be followed by letting of contracts for placing rock asphalt topping. When the two miles in Atacosa County are finished the San Antonio-Laredo highway will be completed to the La Salle County line and contracts for hard surfacing will be let.

Extensive Improvements Announced by M., K. & T.

An extensive program of improvement involving a total expenditure of approximately $15,000,000 will soon be put into execution by the Missouri, Kansas and Texas Railway Co., according to W. H. Landman, commercial agent at Ft. Worth, Texas. The undertaking is the greatest to be announced by any of the Southwestern roads in recent years and will include vast additions and improvements along the Katy's lines. New locomotive shops are to be built at Waco, Texas at a cost of $1,500,000; the Ray freight terminal at Denison, Texas, started a year ago, will be completed at a cost of $350,000; and new freight depots will be erected at Ft. Worth, Waco, and Wichita Falls, Texas. New freight depots have recently been completed at Dallas, Texas and Oklahoma City, Oklahoma.

Lumber Industry Approaches End of 1922 in Good Condition

A composite of the views of the different softwood lumber manuacturing associations, received by wire Dec. 21, by the National Lumber Manufacturers' Association, as to the present business position of the industry, indicates a sound condition at the close of the year. On the whole transportation conditions are much improved; labor is more plentiful, although there is still a tendency toward higher wages; and demand seems to be unusually strong for what is ordinarily a dull season in the lumber industry. As weather conditions compel a degree of suspension of production in the north and on the West Coast, the new business is keeping step with production.

Shipments Improved

The Southern Pine Association wires from New Orleans that although the orders of Southern Pine manufacturers have piled up heavily because of the car supply stringency, "this situation has been generally alleviated and shipments during November were approximately 25 per cent higher than in October, and this tendency appears to be continuing. Last week's reports show record-breaking demand and reflect more favorable conditions than in any similar period of any previous year. Although it is customary for mills to let up at this time of year, our 'barometer' shows that orders received were 78 per cent higher than the average of the same week for the past four years, shipments 40 per cent larger, production 19 per cent greater. December sales prices for Southern Pine show little change from prices of sales in the preceding month but represent an advance of about 30 per cent over January 1, 1922."

The West Coast Lumbermen's Association telegraphs from Seattle: "Heavy snow and cold weather of the past ten days are responsible for the decreased production of mills. For past three days weather has been warmer with chinook wind rapidly removing snow; if it continues a few days will permit resumption of logging operations immediately after Christmas. The available log supply in the water is limited. Both domestic rail and water-borne shipments demand is good. The offshore demand continues steady and heavy inquiries are reported from lumber yards. The

car supply has been slightly better for the past three weeks but is now being curtailed by middle western snow and cold weather which are retarding the movement of empties as well as of loaded cars. It is the general understanding that demand and stock conditions will cause a shortening of customary Christmas shut-down."

The Northern Pine Manufacturers' Association wires from Minneapolis: "Of the nine mills reporting this week only four are sawing. Stocks are rather broken and two mills report them to be below normal; with the others they are normal. There is a scarcity of lower grade boards. The car supply is about sufficient to meet requirements. There is still a shortage of labor in the woods but conditions are improving and the weather is favorable to logging operations. Total shipments of Northern pine for 1922 will exceed production by from 30 to 35 million feet."

From San Francisco, the California Redwood Association wires that the labor supply is satisfactory, the car supply short but slightly better and weather conditions unfavorable, but orders and shipments still well above normal. The California and foreign demand is heavy and the eastern demand is satisfactory.

Telegraphing from San Francisco also, the California White and Sugar Pine Manufacturers' Association reports the labor supply to be normal and likewise the car and log supply. "But most mills in the California pine region are closed as usual at this season on account of weather conditions. Stocks are below normal. The largest demand is from Missouri River points."

The total number of mills reporting to the National Lumber Manufacturers' Association for the week ending Dec. 16 was 395, as against the revised number of 406 for the preceding week. Due almost, if not wholly, to weather conditions, both of a seasonal and exceptional nature, the production of these mills fell off about 18,000,000 feet from that of the preceding week.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 7; the next, on January 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.14	$3.95	$4.40	$3.02½	$3.15	$3.85	$3.25	$3.80	$3.50
Structural rivets, 100 lb.	3.85	4.60	5.25	3.75	4.00	4.80	4.75	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.04	3.85	3.45	2.92½	3.05	3.62½	3.35	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	52.50%	45%	59½%	57-5%	41%	39.2@51.8%	40%	30.00
Cast-iron pipe, 6 in. and over, ton	—54.50	46.32	+57.00	51.67	+55.50	64.11	—52.00	53.50	55.00
Concreting Material:									
Cement without bags, bbl	2.60@2.70	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd	1.00	1.32	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	—2.00	1.65	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	59.00	36.00	40.00	52.00	40.75	39.75	35.00	23.50	90.00
Lime, finishing, hydrated, ton	16.80@ 17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@ 3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	+23.50	—10.60	10.90	11.00	18@19	12.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0796	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1230	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	.93	—.97	+1.07	.95	1.01	1.08	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	.....	.....	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.15). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. **Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.**

Changes Since Last Week

The general situation in the lumber market is at present very firm; with a shortage of cars as the principal factor in holding prices up. The National Lumber Trade Barometer shows production for the entire country at 17 per cent; shipments, 9 per cent and orders, 3 per cent below normal, for the week ending Dec. 22, 1922. This represents a gain of about 2½ per cent in orders; a fraction of one per cent in shipments; and a falling off of 7 per cent in output, during the week. Higher spot coke prices and firmness in pig iron, have combined to force cast-iron pipe quotations $1.50 per ton higher in Dallas and $1, in Minneapolis.

Current business on steel shapes, plates and bars, firm at $2 per 100 lb., Pittsburgh, despite weakening of market in light rails and forging billets. On especially attractive tonnages $1.90 is possible, particularly for car material. The minimum on bars, however, is placed at $1.95, and that to large buyers only.

Common brick advanced slightly in New York market during week due to sustained and unseasonal demand. Quotations now stand at $20 as against $17@20 per M., alongside dock.

Linseed oil market sluggish but prices steady in most cities. Atlanta, however, reports drop of 3c. and Dallas an advance of 2c. per gal., during week.